NYD000824482

Occidental Chemical Corporation

CORRECTIVE MEASURES STUDY OVERBURDEN GROUNDWATER REMEDIATION

• SUPPLEMENTAL PLAN

Buffalo Avenue Plant
Module III - Corrective Action and Waste Minimization Requirements
DEC Permit Number 90-86-0707

OxyChem®

AS FYI

September 2, 1994

ENVIRONMENTAL PROTECTION AGENCY RG II

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AWM-HAZ WASTE FAC. BRANCH

JR

Mr. Paul R. Counterman, P.E., Chief
Bureau of Western Hazardous Waste Programs
Division of Hazardous Substances Regulation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233-0001

Re: Resource Conservation and Recovery Act (RCRA)
Corrective Action Program
NY Permit Number 90-86-0707
Buffalo Avenue Plant
- Corrective Measures Study
Overburden Groundwater Remediation - Supplemental Plan

Dear Mr. Counterman:

Enclosed please find the document entitled "Corrective Measures Study Overburden Groundwater Remediation - Supplemental Plan" for the Buffalo Avenue Plant. Responses to the NYSDEC Comments dated July 27, 1994 on the initial CMS report also are enclosed.

Please call 716-286-3607 if you have any questions or comments regarding this submission.

Yours truly,

James Ky for

Alan F. Weston, Ph.D.
Manager, Analytical Services
Special Environmental Programs

AFW/cm/18

c.c. W. Wertz
A. Straus
K. Maiurano
F. Shattuck
T. Robinson
A. Bellina (2)
B. Withers

Occidental Chemical Corporation
Corporate Environmental Affairs
Occidental Chemical Center
360 Rainbow Boulevard South, P.O. Box 728, Niagara Falls, NY 14302-0728
716/286-3000

Responses to State Comments
Dated July 27, 1994 Regarding the Report Entitled
"Overburden Groundwater Corrective Measures Study,
January 1994"

1) OxyChem is also committed to reducing off-Site chemical migration to the Niagara River to the extent possible. To attain this goal, OxyChem will implement a phased program that will address overburden groundwater leaving the Plant Boundary, and groundwater infiltration into the outfall sewer system. OxyChem will insure that sufficient water treatment capacity is available.

2) The Supplemental Plan for the OGCMS includes a revised schedule for implementation of Corrective Measures which focuses on the overburden groundwater leaving the Plant Site. A plan for determining where and how to reduce groundwater infiltration into the Outfall Sewer system is also included.

3) OxyChem agrees that the Barrier Wall represents a significant component of the Overburden Groundwater Remedial Program. Should the Corrective Measures to be implemented in the southwest corner of the Plant (Area 1) not be effective, OxyChem will enhance the proposed system to address groundwater that may be deflected toward the NYPA Power Conduits by the Barrier Wall.

4) As presented in the Supplemental Plan, the primary focus of the OGCMS will be to reduce overburden groundwater leaving the Plant Site and groundwater infiltration into the Outfall Sewer System. Once these remedies are in place, the capture zones will be determined. Rather than further speculating at this time, it is proposed that the plan be implemented as described. Thereafter, any other source areas that require remediation can be identified. Dense NAPLs will be addressed in the next phase of the Corrective Measures Program (Overburden Soils).

Occidental Chemical Corporation

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• SUPPLEMENTAL PLAN

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1.0 INTRODUCTION

In January 1994, Occidental Chemical Corporation (OxyChem) submitted to the State a Corrective Measures Study for the overburden groundwater remediation at the Buffalo Avenue Plant (Plant) in Niagara Falls, New York. The document, entitled "Corrective Measures Study - Overburden Groundwater Remediation, January 1994" (OGCMS), identified the following eight areas of the plant as requiring overburden groundwater remediation:

- Area 1 - Southwest U-Area (organic compounds/organic acid compounds/elevated pH plume);
- Area 2 - C/D-Area (organic compounds/organic acid compounds/soluble phosphorus plume);
- Area 3 - N-Area (organic compounds/organic acid compounds plume);
- Area 4 - F-Area (organic compounds/organic acid compounds/soluble phosphorus plume);
- Area 5 - G/H-Area (elevated pH plume);
- Area 6 - Southwest U-Area (elevated pH/soluble phosphorus plume);
- Area 7 - Northwest V-Area (soluble phosphorus plume); and
- Area 8 - M-Area (soluble phosphorus plume).

The proposed corrective measure selected to address the eight areas is to convert abandoned sewers at the Plant into overburden groundwater collectors.

OxyChem met with the State on July 21, 1994 to discuss the OGCMS and received comments on the OGCMS on July 27, 1994. The State was in agreement with the concept of converting abandoned sewers into overburden groundwater collectors, however, the State expressed concerns as to being able to definitively determine their effectiveness in meeting the remedial goals for the Plant.

The remedial goals for the Plant overburden groundwater regime are:

- Restrict off-site migration of OxyChem hazardous waste constituents in the overburden groundwater;

- Restrict discharge of OxyChem hazardous waste constituents to the outfalls;

- Restrict discharge of OxyChem hazardous waste constituents to the sanitary sewers;

- Restrict migration of OxyChem hazardous waste constituents from the overburden to the bedrock;

- Minimize need for future/ongoing remediation and operation and maintenance activities by implementing solutions or technologies that will be reliable and effective over the long term;

- Maintain compatibility with remedial efforts for specific areas of the Plant (e.g. S-Area and any off-Site remediations) and with Plant operations;

- Protect City of Niagara Falls drinking water supply system components at the Buffalo Avenue Plant from releases of hazardous waste constituents;

Based on discussions between OxyChem and the State at the July 21, 1994 meeting, the remedial plan for the overburden groundwater flow regime at the Plant was modified from that presented in the OGCMS to a more diverse plan that specifically addresses the plumes as they leave the Plant property. The modified plan developed is consistent with the concepts presented in the OGCMS but improves on the ability to reduce the loading and measure the results.

The modified plan will use overburden groundwater collection systems in locations where chemicals are leaving the Plant Site via the overburden groundwater flow regime. In conjunction with the perimeter capture plan, OxyChem will investigate groundwater infiltration into the Outfall Sewer System with the intent to eliminate those infiltration points that can be cost effectively eliminated and thereby reduce the chemical loadings. To this end, each of the groundwater extraction plans previously presented in the initial OGCMS report will be evaluated to determine which will be implemented and when. At this time, the use of abandoned sewers in Areas 1 and 3 will be implemented while the remaining six will await the results of further evaluation.

The purpose of this document is to present the details of the modified plan and to provide additional background information to support the concepts presented in the OGCMS. This document is presented as a supplemental document to the original OGCMS.

1.1 BACKGROUND

There are three components that contribute to off-Site chemical migration via the overburden at the Plant. These components are the overburden groundwater flow regime, the sanitary sewer system and the outfall sewer system. Off-Site chemical loadings from these components were estimated in the final SDCP Report and were as follows:

Component	*Chemical Loading expressed as TOX/TOC (lbs/day)*
Overburden	24.5
Sanitary Sewers	45.2
Outfall Sewers	58.1
	127.8

The overburden groundwater flow regime has been subdivided into five flow zones (see OGCMS). As stated in the OGCMS, the majority of off-Site chemical migration via the overburden groundwater flow regime occurs in the southwest corner of the Plant (approximately 90 percent). This flow enters the lower Niagara River via the NYPA Power Conduit drain system. A small component (approximately eight percent) of off Site chemical migration also occurs in the northeast corner of the Plant. Although this northeast component migrates beyond the Plant property boundary, it is not released to the environment since this flow is captured by the Energy Boulevard Drain Tile System (EBDTS). This is further discussed in Section 5.1.3.

Overburden groundwater also infiltrates into both the sanitary and outfall sewer systems. The outfall sewer system discharges to the Niagara River either directly or via the City of Niagara Falls storm sewer system. All Plant outfall sewer discharges are monitored under the State SPDES program and are maintained in compliance with discharge limits.

The sanitary sewer system at the Plant discharges to the City of Niagara Falls sanitary sewer system. The sanitary flows are subsequently treated by the City of Niagara Falls Wastewater Treatment Plant (WWTP) and discharged to the Niagara River. The WWTP discharges to the Niagara River are also monitored by a SPDES permit and are maintained in compliance with the discharge limits.

2.0 PROPOSED REMEDIAL PLAN

The following four point remedial plan has been developed by OxyChem to meet the Plant overburden groundwater remedial goals. The primary concepts of the overburden remedial plan are as follows:

A) RESTRICT OFF-SITE GROUNDWATER DISCHARGES

Remedial activities to collect off-Site groundwater discharges in the southwest corner of the Plant will be implemented as described in Section 5.0. This will eliminate approximately 90 percent of the off-Site chemical migration through the overburden groundwater regime.

The EBDTS currently collects approximately 8 percent of the remaining off-Site chemical migration in the northeast sector of the Plant. The combined effect of groundwater collected from these two areas will result in a 98 percent reduction in off-Site chemical loading due to overburden groundwater flow.

Groundwater collection in the southwest corner will be accomplished by installation of a groundwater collection system and conversion of abandoned sewer sections to groundwater collection sewers. The collected groundwater will be treated at the U-Area carbon treatment plant.

B) RESTRICT GROUNDWATER INFILTRATION INTO OUTFALL SEWER SYSTEM

Corrective Measures to reduce the off-Site chemical loading due to outfall sewer infiltration will be addressed by:

1) An initial evaluation of the outfall sewer system to identify sewer sections that contribute substantial chemical loads; and

2) Implementation of corrective measures where appropriate to address areas of groundwater infiltration.

The corrective measures may address both total chemical loading and specific areas of concern.

This program will be implemented under joint authority of the State Corrective Measures Program and SPDES program, and will be approved by both groups prior to implementation.

Corrective measures may include one or more of the following remedial technologies:

i) sewer lining, sewer closure, sewer re-routing; and

ii) additional groundwater extraction by tile collection system extension, groundwater extraction well installation or enhancement of the abandoned sewer sections capability to collect groundwater (i.e., perforation, or lateral tile connections).

Section 4.0 describes the corrective measures program to address the outfall sewers at the Plant.

C) SANITARY SEWER USE

OxyChem will continue to use the sanitary sewer system as it currently operates, because treatment of the sanitary sewer discharges is performed by the City of Niagara Falls WWTP. Thus the overburden groundwater which currently infiltrates into the sanitary sewer system will continue to be treated.

3.0 EFFECTIVENESS OF PREVIOUSLY IMPLEMENTED LOADING REDUCTION PLANS

OxyChem has been active in achieving significant loading reductions within the Plant outfall and sanitary sewer systems. Implementation of loading reduction plans commenced in late 1979 and continue today. Loading reductions have been achieved by implementation of corrective measures to eliminate groundwater infiltration. These measures have included sewer lining, sewer grouting, closure of obsolete connections, closure of obsolete process discharges, installation of new sewer components, and surface capping to minimize the infiltration potential.

The following subsections describe the effectiveness of corrective measures which already have been implemented on the outfall and sanitary sewers to reduce chemical loadings.

In summary, the effectiveness of chemical loading reduction is demonstrated in the following examples:

- TOX loadings in the outfall sewers decreased from 150 lb/day in 1980 to 19 lb/day in 1990 for a reduction on the order of 87 percent;

- Total organic loadings, consisting of toluene, benzene, and selected chlorinated compounds have decreased approximately 37 percent (from 30.5 lbs/day in 1984 to 19.3 lbs/day in 1990 for the sanitary sewers (see Figure 3.7) and 93 percent (from 116 lbs/day in 1984 to 8 lbs/day) in 1990 for the sum of the outfalls (see Figure 3.8);

- From 1986 to 1990, TOC has decreased by approximately 75 percent (from 161 lbs/day to 39.5 lbs/day) for the sum of the outfalls and has decreased slightly for the sanitary sewers. It is noted that the principal source of TOC in the sanitary sewers is human waste which is not representative of Plant processes or groundwater infiltration; and

- Not only have the chemical loadings decreased but the total discharge flow for the sum of the outfalls and sanitary sewers has decreased approximately 45 percent (from 37 mgd in 1983 to 20 mgd in 1990). The observed reductions in the loadings and flow also reflect reductions due to specific process changes.

3.1 SEWER SYSTEM PHYSICAL DETAILS

The existing sanitary and outfall sewers in the Plant are constructed mainly of butt-jointed vitrified clay pipe, ranging in size from 4 to 54 inches in diameter. More recently, sewer construction has used materials and methods that provide a more watertight condition (e.g., reinforced concrete pipe with watertight joints and high-density polyethylene (HDPE) pipe with watertight fused joints). OxyChem will use watertight construction methods for all future sewer construction.

3.2 SEWER SYSTEM MODIFICATIONS

Historical sewer installations did not use watertight construction materials and methods, subsequently, groundwater infiltration into the sewer systems has occurred. Throughout the late 1970s and to the present, OxyChem has been upgrading the sewers to improve the water quality exiting the Plant.

Table 3.1 presents a chronological listing of the outfall and sanitary sewer system modifications made at the Plant.

The modifications made which have resulted in significant loading reductions/improved discharges are described as follows:

- Iroquois Street Sanitary Sewer

During the 1980-1985 time period, a significant amount of the Buffalo Avenue Plant was undergoing closure which included subsurface utility abandonment. Numerous lateral sewer sections and stubs were abandoned in select areas of the Iroquois sanitary system. Table 3.1 identifies the areas of sewer closure and time frame of abandonment.

In 1991, a section of the N-Area sanitary sewer was lined to minimize groundwater and NAPL infiltration. Additionally, repairs, cleaning and lining of manholes was completed.

In 1993, sections of the K-Area sanitary sewer were replaced to reduce NAPL and groundwater infiltration in the vicinity of K-27, K-11d, K-31, K-4 and K-15.

Figure 3.1 shows the total organic loading measured in the Iroquois Street Sanitary Sewer for the time period from July 1983 to June 1993. The chemicals included in the total organic loading are listed on Table 3.2. As shown on Figure 3.1, actions implemented in the fall of 1991 in the N-Area decreased the organic loading from up to 17 lbs/day to on the order of 6 lbs/day. The trend apparent on Figure 3.1 is that the total organic loadings are declining over time.

- 47th Street Sanitary Sewer

Similar to the Iroquois sanitary sewer, numerous stubs and laterals to the 47th Street sanitary sewer were closed during Plant demolition activities. Table 3.1 identifies the areas of sewer closure and time frame of sewer abandonment.

- 001 Outfall

Modifications to Outfall 001 include the lining of the southern sections in addition to the abandonment of several sections in the U-Area. Other activities have included:

- installation of a pH adjustment unit at MH585;
- construction of a new sewer connection from Building U-87;
- manhole restoration, including cleaning, parging, pressure grouting of the exterior of the manhole and lining of the interior with Fosroc;
- sewer cleaning; and
- inspection/sampling activities.

Figure 3.2 shows the total organic loading measured in Outfall 001 for the time period from January 1981 to December 1993. The average daily loading reduced from approximately 15 lbs/day (4.1 lbs/day deleting the one value of 370 lbs/day) for the time period from September 1983 to June 1985 to 0.6 lbs/day for the time period from July 1985 to April 1988.

- <u>002 Outfall</u>

In 1982, the entire 002 Outfall was abandoned eliminating the chemical loading from this section of sewer to the Niagara River.

The 002 Outfall system was a contributor to chemical loadings to the Niagara River. In 1982, OxyChem diverted and/or abandoned the flows entering the 002 Outfall so that the entire 002 Outfall could be abandoned. This resulted in a reduction of chemical loadings to the Niagara River.

- <u>003 Outfall</u>

Numerous sections of the 003 Outfall have been abandoned as described in Table 3.1. Additionally, S-Area remedial construction activities have reconstructed and replaced portions of 003 Outfall with watertight fused HDPE piping.

Figure 3.3 shows the total organic loadings measured in Outfall 003 for the time period of January 1981 to December 1993. The average daily loadings reduced from 25 lbs/day for the time period of January 1984 to June 1985 to 4.4 lbs/day from July 1985 to February 1991. As shown on Figure 3.3, the S-Area utility relocations appear to have further reduced the average daily organic loadings to 2.4 lbs/day from May 1991 to December 1993.

4.0 OUTFALL SEWER CORRECTIVE MEASURES

As discussed with the State at the July 21, 1994 meeting, OxyChem will implement corrective measures on the Outfall sewer system to reduce the off-Site chemical loading. In order to develop the corrective measures, an investigation of the existing outfall sewer system will be completed to identify sewer sections where groundwater infiltration is contributing chemical loading to the outfall system. Once complete, specific corrective measures to address sewer sections which need attention will be identified and an implementation plan for the corrective measures will be developed. Details of the program are provided in the following subsections.

4.1 INVESTIGATION

The investigation to evaluate outfall conditions will involve:

- sewer inspection and confirmation of the physical sewer layout;
- sampling and analysis; and
- flow measurement to determine chemical loading estimates.

The outfall sewer investigation will be conducted in two phases. The first phase will investigate chemical loadings and chemicals of concern in mainline sections of the four outfalls. This will involve the following:

- Assemble current outfall sewer plans which detail the sewer system layout;
- Collect dry-weather 24-hour composite samples from appropriate manholes on the mainline sewer sections (the results of up to three 24-hour composites will be averaged);
- Concurrent with sampling, perform instantaneous flow measurements to determine chemical loading estimates; and

- Note sewer conditions, areas of infiltration, deteriorated/damaged sewer components and any unknown contributory stub flows.

The Phase 1 sample locations are shown on Figure 4.1. Each composite sample will be analyzed for the parameters presented in Table 4.1 (Sewer Study SSI list). These parameters are the primary Plant Site-Specific Indicator (SSI) parameters present in the overburden groundwater at the Plant. The Plant SSI list was reviewed and compared to the Great Lakes Water Quality Initiative's (GLWQI) list of 18 Toxic Priority Chemicals of concern and, the 1993 SPDES results for the toxic chemicals of concern.

The parameters selected for the Sewer Study SSI list (Table 4.1) are those compounds most likely present due to groundwater infiltration. Compounds on the Plant SSI list or the GLWQI that have not been detected in the outfall discharges or are of a very low concentration, have not been included in the Sewer Study SSI list. Appendix A presents the rationale used to select the sewer study analyte list.

Once completed, the Phase 1 data will be reviewed to develop the Phase 2 sampling activities. Phase 2 activities will involve the investigation of the sewer laterals or sections identified by Phase 1 studies as being significant contributors of chemical loading in the Outfall sewer system. Phase 2 activities will be performed in the same manner as the Phase 1 techniques but will concentrate on select Plant areas or discrete sewer sections to locate chemical loading sources.

4.2 DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

Once the chemical loading sources have been located, a cost/benefit analysis will be conducted to determine which sewer segments are to be addressed and in which order.

OxyChem will develop corrective measure alternatives to address the outfall sewer segments warranting remedial action. Potential corrective measure alternatives to be considered include:

i) abandon outfall sewer section and eliminate or reroute the existing flows that are using the sewer section;

ii) abandon outfall sewer section and discharge existing flows to the sanitary sewer system;

iii) line the outfall sewer section with a watertight material to eliminate groundwater infiltration;

iv) abandon the outfall sewer section and construct a new outfall sewer using watertight pipe materials (i.e. HDPE pipe); and

v) dewater the area in the vicinity of the outfall sewer section by either:
   - converting nearby abandoned sewers to groundwater collectors,
   - constructing a new tile collection system parallel to and deeper than the outfall sewer or,
   - installing groundwater extraction wells.

4.3 IMPLEMENTATION

The corrective measures developed for each outfall sewer section will be evaluated to determine the effectiveness of reducing chemical loadings to the outfall sewer system. A cost/benefit analysis will be performed to determine an implementation plan. The corrective measure for each outfall sewer section will be ranked based on the degree to which chemical loadings or chemicals of concern in the outfall sewer system will be reduced and on economic feasibility. Corrective measures that have the highest potential to reduce chemical loadings (both bulk loading reductions and specific compound reductions will be considered) and are the most economically feasible will be implemented first. The cost/benefit analysis ranking will be used to determine how many implementations are appropriate.

At the completion of this evaluation, OxyChem will submit to the State a report documenting the results of the Phase 1 and 2 Investigations, a discussion of the corrective measure development process and a detailed schedule for implementation of the corrective measures based on the cost/benefit ranking analysis.

5.0 OVERBURDEN GROUNDWATER CORRECTIVE MEASURES

The OGCMS evaluated the chemical migration potential within perimeter and interior areas of the Plant. Through the discussions held with the State, it has been agreed that the primary objective of the OGCMS will be to reduce the chemical loadings crossing the Buffalo Avenue Plant boundary. The chemical loadings in the overburden groundwater flow regime were quantified in the SDCP Report. Based upon the flow quantity and quality, it is possible to develop a Corrective Measures plan to address the off-Site discharges. The following section reviews the off-Site chemical migration patterns, and recommends corrective measures where required.

5.1 OFF-SITE CHEMICAL MIGRATION

The overburden groundwater flow leaving the Plant was subdivided into five flow zones in the SDCP Report. Figure 5.1 shows the location of the five perimeter flow zones. The respective off-Site chemical flux estimates for each flow zone are as follows:

Flow Zone	*Perimeter Area*	*Off-Site Flow (gpd)*	*Most Likely Mass Flux expressed as TOX/TOC (lbs/day)*
1	South Boundary	9,700	22.1
2	East Boundary	540	0.02
3	North Boundary - East	2,500	2.03
4	North Boundary - West	2,200	0.3
5	West Boundary	4	0.001
		Total	24.5

The chemical mass flux estimates shown are considered the most likely estimate of chemical migration based on the mean TOC/TOX concentrations at the Plant boundary and assuming a precipitation infiltration rate of 14.3 inches per year. The OGCMS summarizes the development of the chemical flux estimates and factors affecting the reliability of these values (see Section 2.4.1 - Perimeter Overburden Chemical Migration within the OGCMS).

5.1.1 Flow Zone 1 - South Boundary

The chemical mass flux from flow zone 1 represents 90 percent (22.1 lb/day) of the chemical mass flux leaving the Plant through the overburden groundwater. The groundwater flow direction along the southern Plant boundary is initially to the south and then to the west following along the alignment of the Industrial Intake Pipe Trench. The flow is intercepted by the New York Power Authority's (NYPA's) conduit drain system which eventually discharges to the lower Niagara River.

No overburden groundwater discharge from the Plant enters the upper Niagara River as the construction of the Plant Barrier Wall and the existance/enhancement of the inward gradient through the wall have eliminated this possibility. Flow Zone 1 will be addressed to attain a substantial reduction of the chemical mass flux leaving the Plant boundary.

5.1.2 Flow Zone 2 - East Boundary

The flow zone 2 chemical mass flux is very small comprising 0.1 percent (<0.1 lb/day) of the total overburden groundwater mass flux leaving the Plant. Figure 5.1 shows the groundwater flow paths for flow zone 2. South of Buffalo Avenue the groundwater flows south and east toward the S-Area. Construction of the S-Area Barrier Wall (scheduled for completion in 1994) will prevent off-Site chemical migration from this portion of flow zone 2.

Groundwater within the portion of flow zone 2 north of Buffalo Avenue flows east toward 56th Street, south toward Buffalo Avenue and west toward 53rd Street. The westerly and southerly component of groundwater flow is created by the influences of sanitary sewers beneath 53rd Street and Buffalo Avenue. Off-Site chemical migration from these areas is captured by the sanitary sewers and treated at the WWTP. The easterly component of groundwater flow exhibits extremely low levels of chemical presence as indicated by SSI sampling. Wells OW311 and OW323 have concentrations below 22 µg/L.

Therefore, chemical migration from flow zone 2 is not a significant off-Site discharge requiring remediation.

5.1.3 Flow Zone 3 - North Boundary - East

The flow zone 3 chemical mass flux represents approximately 8 percent (2 lb/day) of the total mass flux leaving the Plant through the overburden groundwater.

The off-Site flow estimates show that approximately 2,500 gallons per day crosses the Plant boundary from this zone. The westerly portion of this flow zone is captured by the Energy Boulevard Drain Tile System (EBDTS) which collects groundwater and NAPL. The groundwater is discharged to the Iroquois Street sanitary sewer for treatment. The NAPL is contained within a wet well and is periodically collected from the wet well and disposed. Flow measurements taken during dry weather conditions show groundwater collection rates ranging from 2.4 gpm (April 1982) to 10.0 gpm (April 1991). The average groundwater collection rate is 6.0 gpm. On a daily basis this amounts to 8,600 gallons per day. The EBDTS creates a radial capture zone around the system and captures groundwater from areas north, south, east, and west of the system. Assuming that half of this flow originates from off-Site areas, the remaining flow captured by the EBDTS is from the Plant perimeter (i.e. 4,300 gallons per day). Off-Site groundwater flow from flow zone 3 was estimated to be 2,500 gallons per day. Comparison to the EBDTS dry weather flow measurement average of 4,300 gallons per day shows that the EBDTS is effective in this flow zone and likely captures the majority of off-Site groundwater flow and chemical loading from this boundary of the Plant .

The EBDTS was installed to prevent groundwater from infiltrating into the storm sewer which had been constructed to drain Energy Boulevard. As discussed in Section 3.3.2.4, the EBDTS has been effective in reducing chemical loading in the storm sewer along Energy Boulevard to levels below discharge limits. It should be noted that the storm sewer on Energy Boulevard extends substantially to the east and west of the EBDTS. The fact that chemical loading in the storm sewer remains below discharge limits supports the postulation that the EBDTS captures the majority of off-Site chemical migration from flow zone 3.

The effectiveness of the EBDTS is further substantiated by the Off-Site Investigation (OSI) and SSI sampling performed and the hydraulic monitoring data collected. The analytical data presented in the OGCMS show that the wells north of Energy Boulevard have minimal chemical presence. Hydraulic monitoring data also show groundwater flow gradients to the EBDTS demonstrating effective capture of the off-Site overburden groundwater flow. Consequently, the remediation for flow zone 3 is already in place and has been operating effectively since 1981.

5.1.4 Flow Zone 4 - North Boundary - West

The chemical mass flux from zone 4 represents approximately 1 percent (0.3lb/day) of the chemical mass flux leaving the Plant boundary via the overburden groundwater.

Figure 5.1 shows the groundwater flow pattern of flow zone 4. Two groundwater flow directions exist from this zone; one flow component direction is towards the 47th Street sanitary sewer within the central area of this zone; and secondly, a northwesterly component of groundwater flow exists which likely discharges to the Iroquois Street sanitary sewer. Both systems discharge to the WWTP for treatment (i.e. Iroquois/47th Street sewers). Subsequently, groundwater movement, although minor in mass and volume, ultimately drains into the respective sewers which are treated.

Groundwater movement to the north does not occur as demonstrated by the groundwater contours shown on Figure 5.2, and the low level analytical results of the off-Site overburden groundwater wells north and west of this flow zone.

The Iroquois Street sanitary sewer and its bedding is considered a preferential migration route for overburden groundwater. Groundwater discharge may occur to the sewer itself or to the bedrock regime as this sewer bedding is located on top of or within the bedrock. As indicated, groundwater discharge to the sanitary sewer is treated at the WWTP. If discharge occurs to the bedrock regime, capture and treatment will occur through implementation of the bedrock corrective measures program. Consequently, remedial efforts in this area are not required as a significant off-Site discharge does not occur.

5.1.5 <u>Flow Zone 5 - West Boundary</u>

The chemical mass flux from flow zone 5 represents <0.01 percent (<0.1 lb/day) of the chemical mass flux leaving the Plant through the overburden groundwater. The off-Site flow estimate for this flow zone is on the order of 4 gallons per day.

As shown on Figure 5.1, groundwater from this flow zone flows north toward Buffalo Avenue and west toward Iroquois Street due to the presence of sanitary sewers beneath these streets (Iroquois Street Sanitary Sewer). Therefore the minimal off-Site chemical migration that may occur from this flow zone will be captured by the sanitary sewer system and treated at the WWTP.

The trace chemical mass flux from this flow zone is not a significant discharge requiring remediation.

5.2 CORRECTIVE MEASURES IMPLEMENTATION (CMI)

The OGCMS identified that corrective measure implementation will be a phased/iterative process utilizing groundwater removal as the mechanism to restrict off-Site chemical migration. The groundwater extraction techniques for lowering the groundwater table were reviewed in the OGCMS and a recommendation of converting abandoned sewers to groundwater collectors was selected as the preferred and most suitable technology to address Plant conditions. Where required, alternate technology (i.e. extraction wells, enhanced recovery wells, abandoned sewer enhancement, or tile collection systems) will be employed if hydraulic performance monitoring indicates that the initial sewer conversion does not provide adequate groundwater control. Performance evaluation of the groundwater collection system effectiveness will be accomplished by hydraulic monitoring within overburden wells, the groundwater collection systems, and the converted sewer wet wells and manholes to establish groundwater flow patterns.

5.2.1 Flow Zone 1 - CMI

The OGCMS identified two chemical plume areas within flow zone 1. The plume areas to be addressed within flow zone 1 are:

- Area 1 - Southwest U-Area (organic compounds, organic acid compounds, and elevated pH plume); and
- Area 3 - N-Area (organic compounds and organic acid compounds plume).

Figure 5.2 shows the flow zone 1 organic compound plumes originating from the U-Area (Area 1) and N-Area (Area 3), and Figure 5.3 shows the groundwater flow contours and direction of flow.

Groundwater movement occurs from the Plant perimeter south towards the Robert Moses Parkway, and then turns westerly towards the NYPA conduit intakes.

The pattern of chemical presence evident on Figure 5.3 shows elevated total organic SSI compounds (i.e. >10 mg/L) in areas north of the Robert Moses Parkway extending from the southwest corner of the Plant perimeter (OW300) to the southeast corner of the N-Area (OW269). Whereas, in the areas south of the Robert Moses Parkway, trace chemical presence (i.e. <200 μg/L) typically exists. Groundwater movement from and to the Niagara River has been eliminated by the presence of the NYPA concrete river wall (which is connected to bedrock) and completion of the Plant and S-Area barrier walls (which are keyed into the clay/till surface).

Corrective measures will be most effective in areas adjacent to the Plant perimeter (i.e. abandoned sewers Outfall 001 and 002) where the majority of the Plant related chemical presence exists. Dewatering will be performed along the southern Plant boundary to create a hydraulic gradient back toward the Plant from the area along the Robert Moses Parkway. The dewatering will use the abandoned sewers in the U and N-Areas as described in the OGCMS for this area of the Plant. In areas south of the Robert Moses Parkway, groundwater extraction is not necessary due to the trace chemical presence in this area. Groundwater extraction in the shot-rock fill areas to the south of the Robert Moses Parkway would require a significant pumping effort to overcome the dewatering effect of the conduits and the bedrock groundwater recharge. The bedrock groundwater recharge occurs because the conduit/intake channeling construction which has eliminated the clay/till unit in this area. Given the clean water quality and volume of water present, pumping from the shot rock area is not required.

Once the dewatering of the area is initiated, a hydraulic assessment will be made of the effectiveness of the dewatering. If insufficient containment has been developed, OxyChem will install a new drain tile collection system along the Plant perimeter (see Figure 5.4) to capture any groundwater that migrates beyond the southern Plant boundary and intercept it before it reaches the NYPA conduit drains.

The corrective measure implementation stages proposed for flow zone 1 are shown on Figure 5.4 and are as follows:

Stage 1

- Construct a centralized wet well (CWW1) and pumping system in the area northeast of MH584;

- Connect by collection tile (8-inch diameter) Outfall 001 and Outfall 002 to CWW1. At each outfall connection, a new manhole will be required (MH1A, MH2A);

- Install a pumping system and forcemain from CWW1 to the U-Area carbon treatment plant wastewater holding tank;

- Remove the existing Outfall 002 plug in the 36-inch diameter line;

- Install five monitoring wells to conduct performance monitoring, in conjunction with existing monitoring wells;

- Commence groundwater extraction from abandoned sewer systems;

- Conduct preliminary groundwater performance monitoring;

- Construct groundwater collection tile (8-inch diameter HDPE) from CWW1 to west/northwest along the Plant boundary (CMH1, CMH2), for a length of approximately 350-foot length; and

- Commence groundwater extraction from the combined system of collection tile and abandoned sewers.

Stage 2

- Conduct monthly hydraulic performance monitoring and evaluate the operational system's effectiveness.

Stage 3

- Enhance the system's effectiveness (if required) by:
  - extending the tile collection system; or
  - perforating abandoned sewers to improve collection capability, or
  - connecting tile collection laterals to the abandoned sewers sections.

Once the system's effectiveness is determined a long-term system operation and maintenance program will be developed.

5.2.2 Flow Zone 1 - Performance Monitoring

The effectiveness of flow zone 1 groundwater collection will be evaluated by monitoring the groundwater levels within overburden wells, the collection tile system and the abandoned sewer system. The resulting elevation data will be contoured to show groundwater flow patterns during system operation. Figure 5.5 shows the monitoring well and collection system locations from which hydraulic elevation data will be collected. Five new overburden wells will be installed to monitor the effects of groundwater removal. Wells will not be installed in areas of the underground industrial intake pipe trench or the overhead transmission lines of the Niagara Mohawk power corridor.

6.0 SANITARY SEWER

At this time, OxyChem will not propose corrective measures on the sanitary sewer system at the Plant. The sanitary systems currently operate within the discharge limit established by the City of Niagara Falls (and the WWTP SPDES Permits); and secondly, these systems provide an essential component of groundwater collection within the Plant area and at the Plant boundary. SDCP estimates show that the loading to the sanitary systems accounts for approximately 34 percent (45 lbs/day) of total chemical mass flux leaving the Plant via the overburden groundwater flow regime. Elimination of this flow to the sanitary system by remedial efforts on the sewers would divert this flow and loading to outfall sewers or off-Site areas. This would lead to the need for additional remedial collection systems and components in areas not required at this time. As conditions currently exist, the overburden flow which discharges to the sanitary sewer is treated prior to discharge to the Niagara River. The sanitary sewer system is an effective collection system and as such will remain part of the overall Plant remedial plan.

The WWTP was originally built with the intent of providing treatment for industrial discharges. OxyChem played a major role through the Industrial Liaison Group that pushed to have the WWTP built and was the largest contributor. OxyChem therefore believes that to continue using the WWTP is an appropriate action.

In the event the City cannot meet its discharge requirements imposed by the SPDES permit on the WWTP discharge, OxyChem will cooperate with the City to evaluate OxyChem's sanitary discharge and implement corrective measures on the on-site sanitary sewer system.

7.0 SCHEDULE

Figure 6.1 shows the proposed schedule for the outfall sewer study and corrective measures implementation, the overburden corrective measures implementation and the performance monitoring required to evaluate the system's effectiveness.

8.0 SUMMARY

This supplemental report completes the Corrective Measures Study for the overburden groundwater flow regime.

The initial OGCMS has shown the areas of chemical plume presence and determined that the appropriate remedial approach will utilize abandoned sewers as groundwater collectors, enhanced where necessary with alternate collection systems. The sanitary sewer system will continue as an element of internal groundwater control in conjunction with the proposed and existing collection systems.

This supplemental plan has reviewed the Site hydrogeologic conditions and shows that corrective measures are primarily required in the southwest perimeter areas (Flow Zone 1) and the outfall sewer network. OxyChem does not believe that Plant-wide collection systems are required. OxyChem believes that implementation of the southerly perimeter collection system and the outfall sewer investigation/corrective measures will minimize off-Site groundwater flow and chemical flux.

The outfall and sanitary sewer monitoring currently in effect for each system provides the necessary documentation on chemical loadings in these systems. Future corrective measures may be implemented should chemical loading conditions change. Additional groundwater control systems, if required, may include:

- conversion of additional abandoned sewers to collection systems;
- tile collection systems; and
- extraction wells.

FIGURES

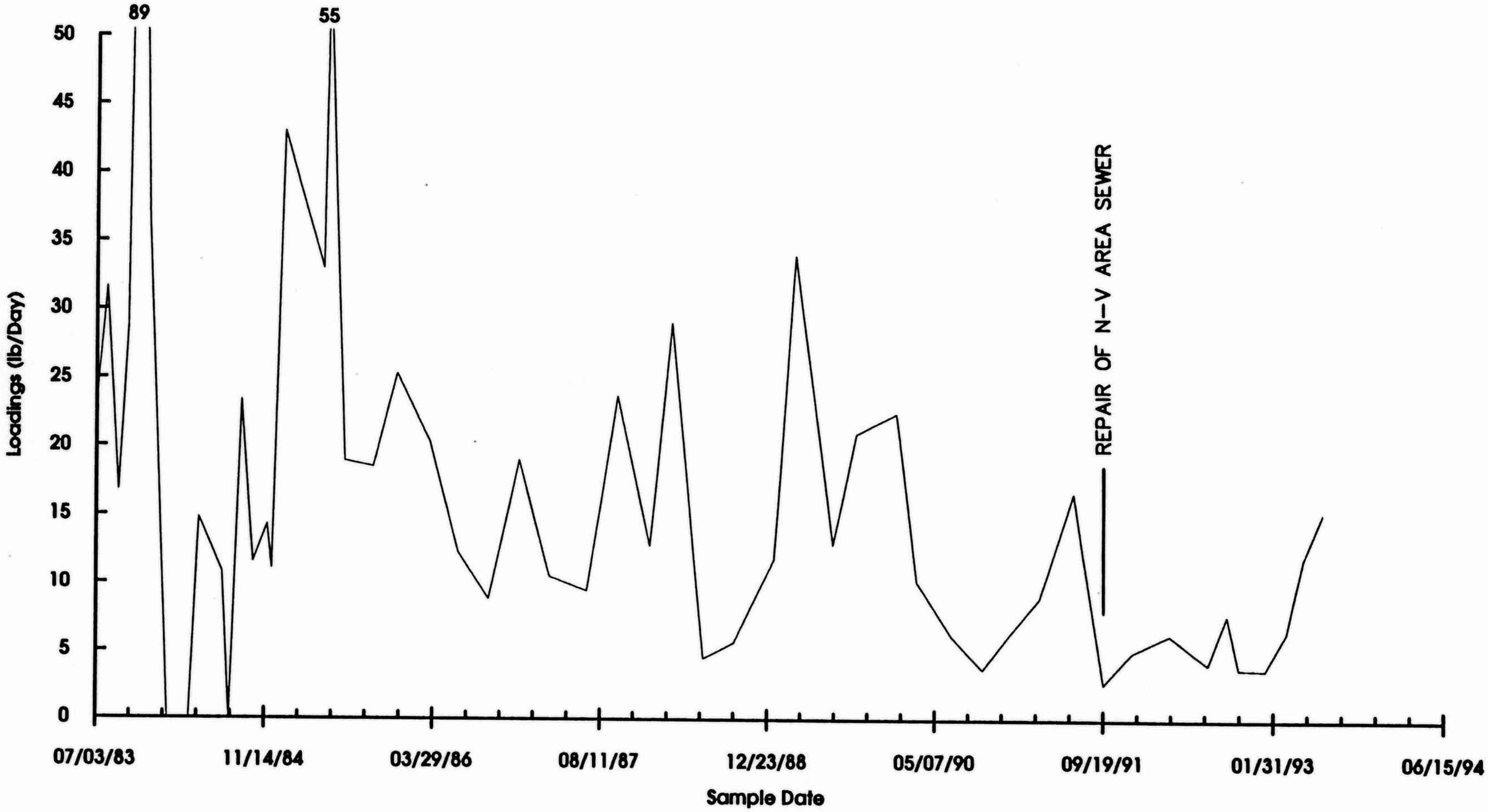


figure 3.1

TOTAL ORGANIC LOADINGS – IROQUOIS STREET SANITARY SEWER
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation – Buffalo Avenue Plant

CRA

2583 (153) AUG.12/94(W) REV.0

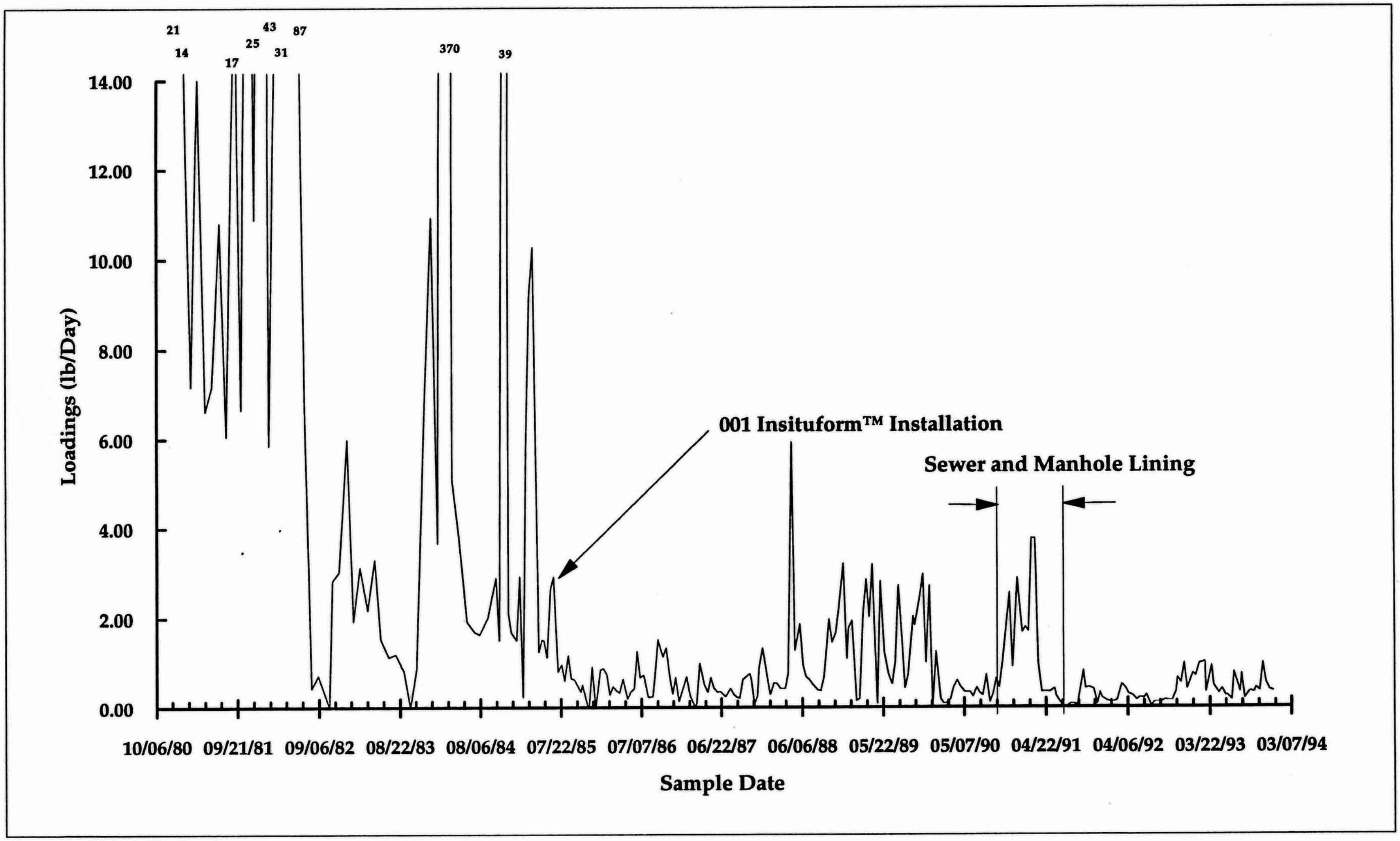


figure 3.2

TOTAL ORGANIC LOADINGS - OUTFALL 001
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation - Buffalo Avenue Plant

CRA

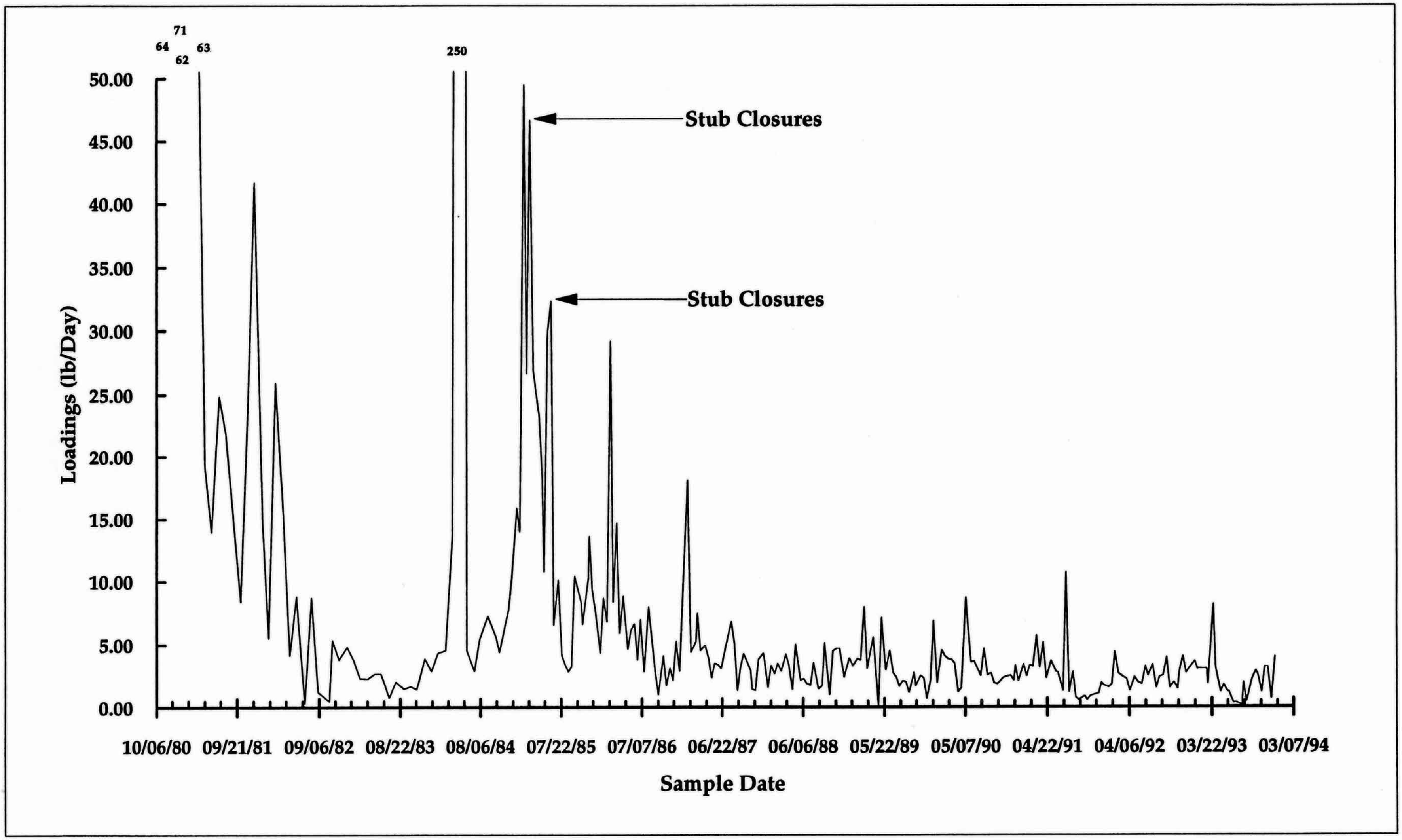


figure 3.3

TOTAL ORGANIC LOADING - OUTFALL 003
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation - Buffalo Avenue Plant

CRA

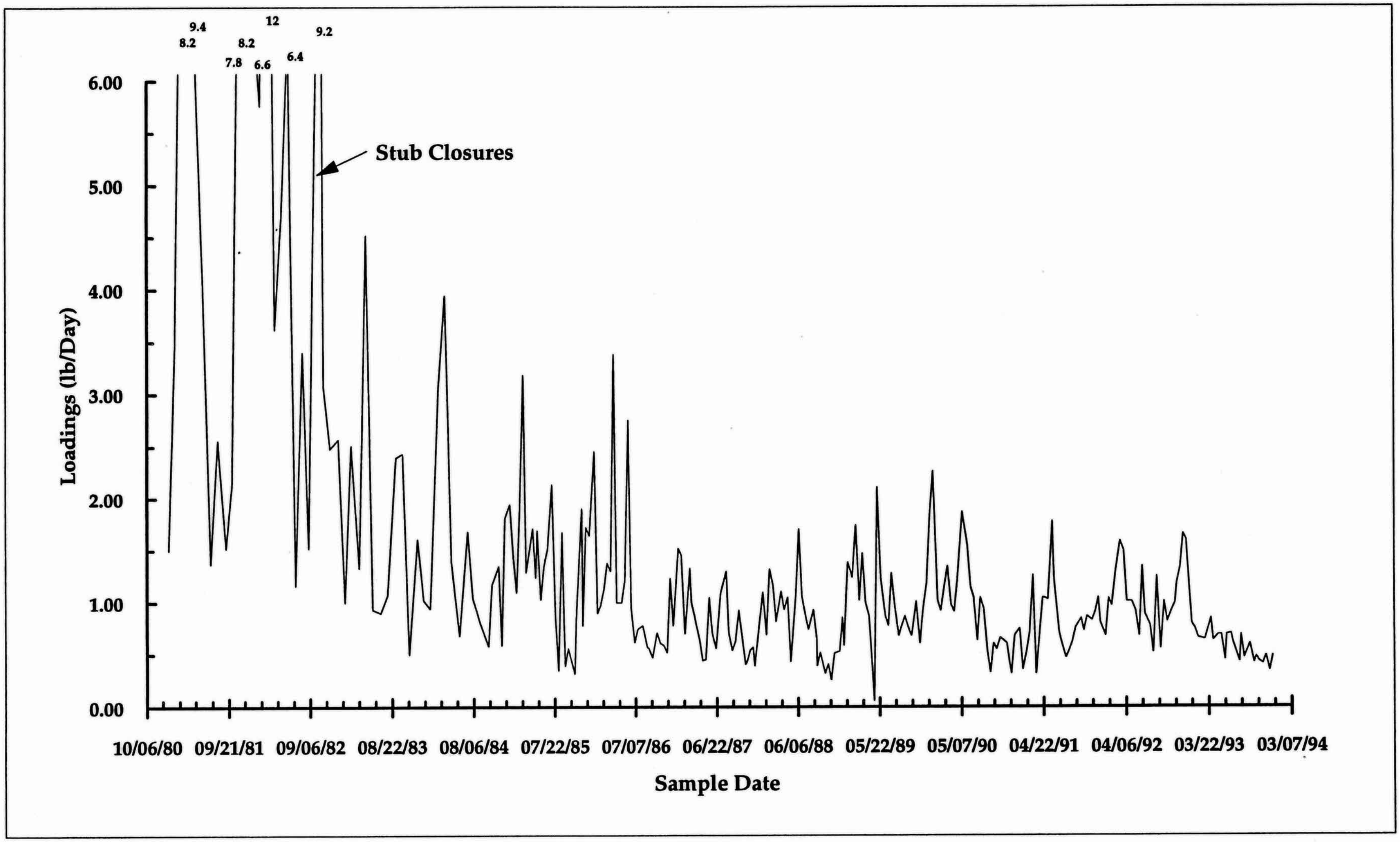


figure 3.4

TOTAL ORGANIC LOADING - OUTFALL 004
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation - Buffalo Avenue Plant

CRA

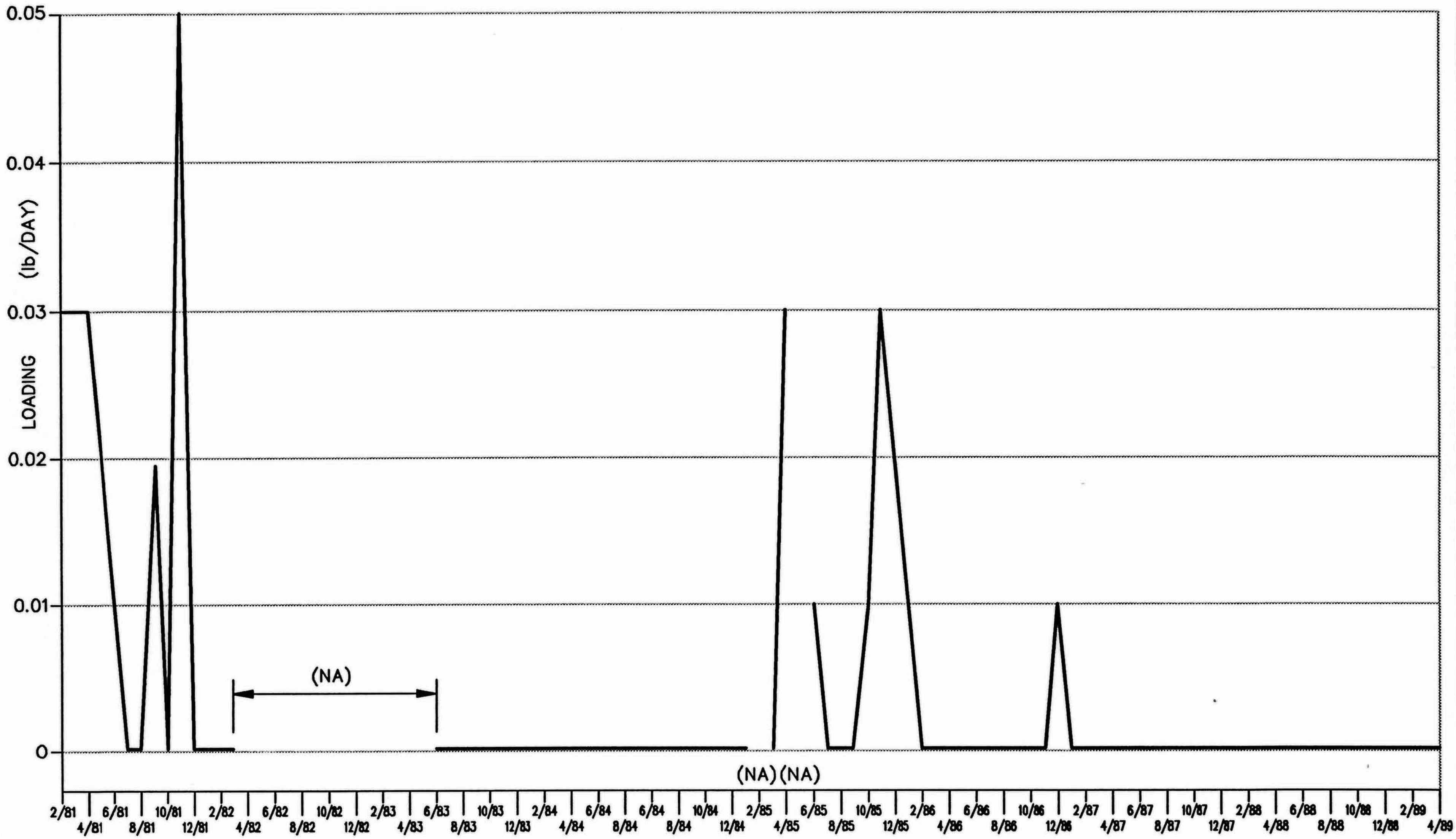


figure 3.5

(NA) DATA NOT AVAILABLE

TOTAL ORGANIC LOADINGS – ENERGY BOULEVARD STORM SEWER
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation – Buffalo Avenue Plant

CRA

2583 (153) AUG 12/94(W) REV.0 (X–75)

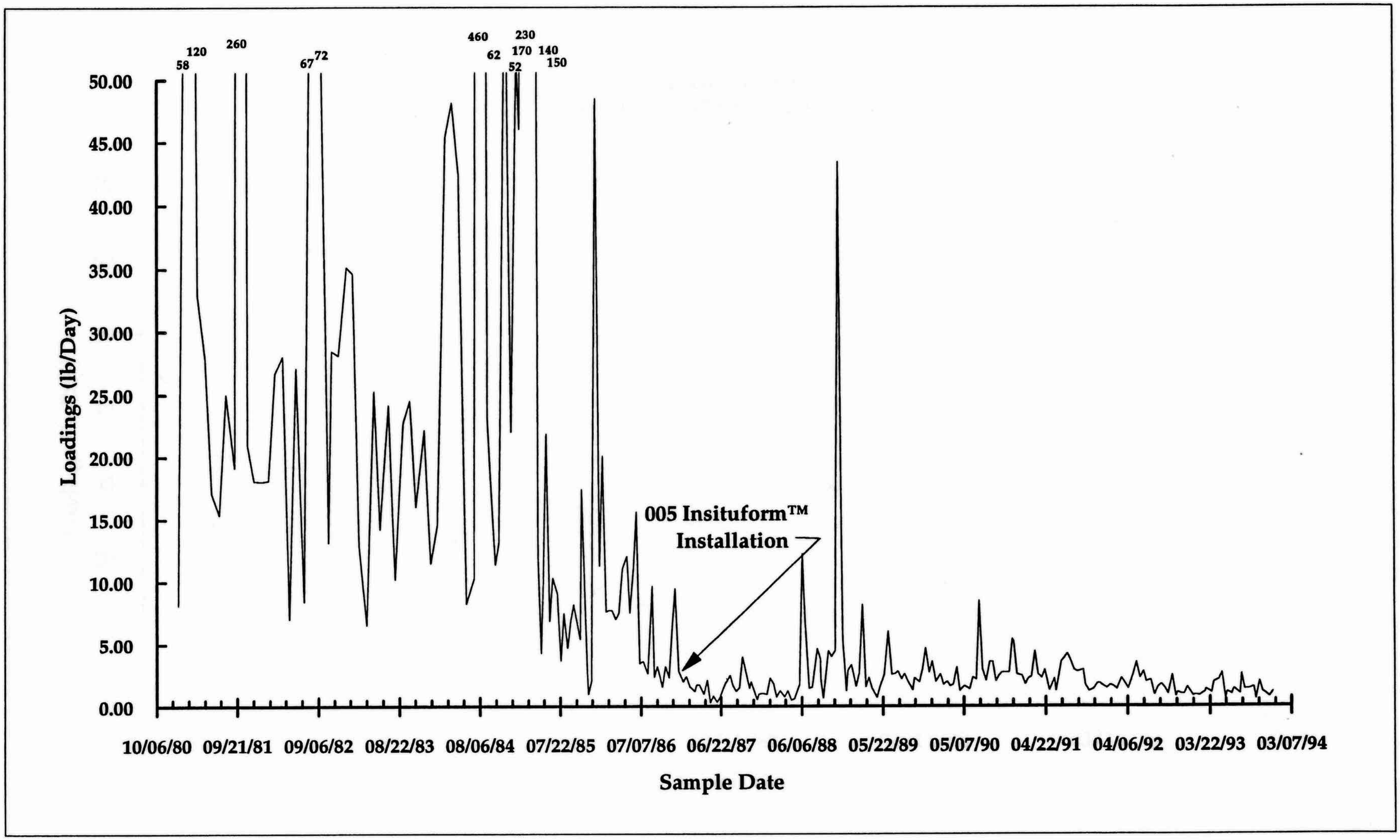
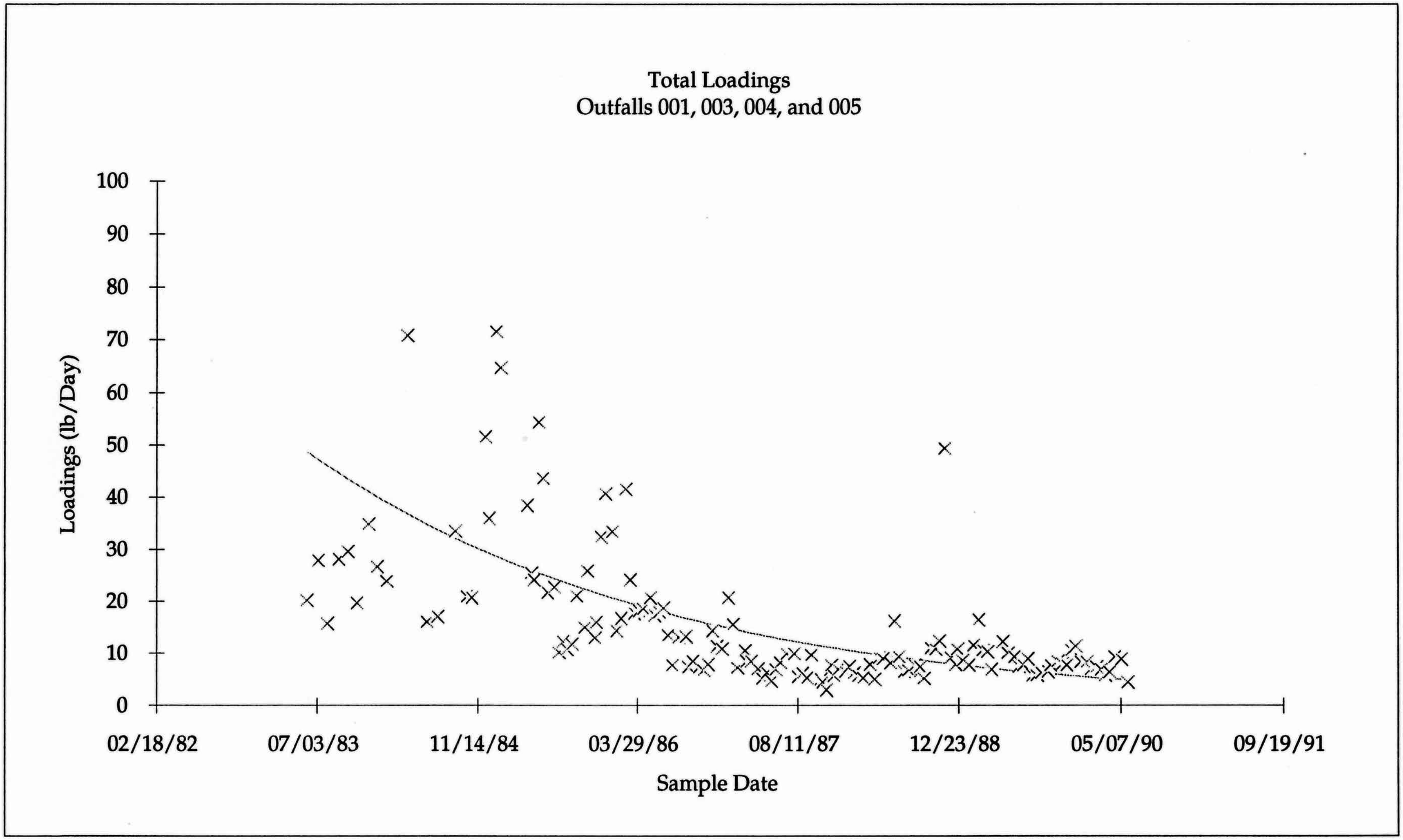


figure 3.6

TOTAL ORGANIC LOADING - OUTFALL 005
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation - Buffalo Avenue Plant

CRA

1979 (14) 8/30/94 (w) [MONITOR.XLW]Outfall 005 - border



(1) LOADINGS ARE THE SUM OF OUTFALLS 001, 003, 004 AND 005
FOR TOTAL OF SELECTED CHLORINATED COMPOUNDS AS WELL AS BENZENE AND TOLUENE

figure 3.8

TOTAL ORGANIC LOADING - OUTFALLS (1) 1983 - 1990

OVERBURDEN CORRECTIVE MEASURES STUDY

Occidental Chemical Corporation - Buffalo Avenue Plant

CRA

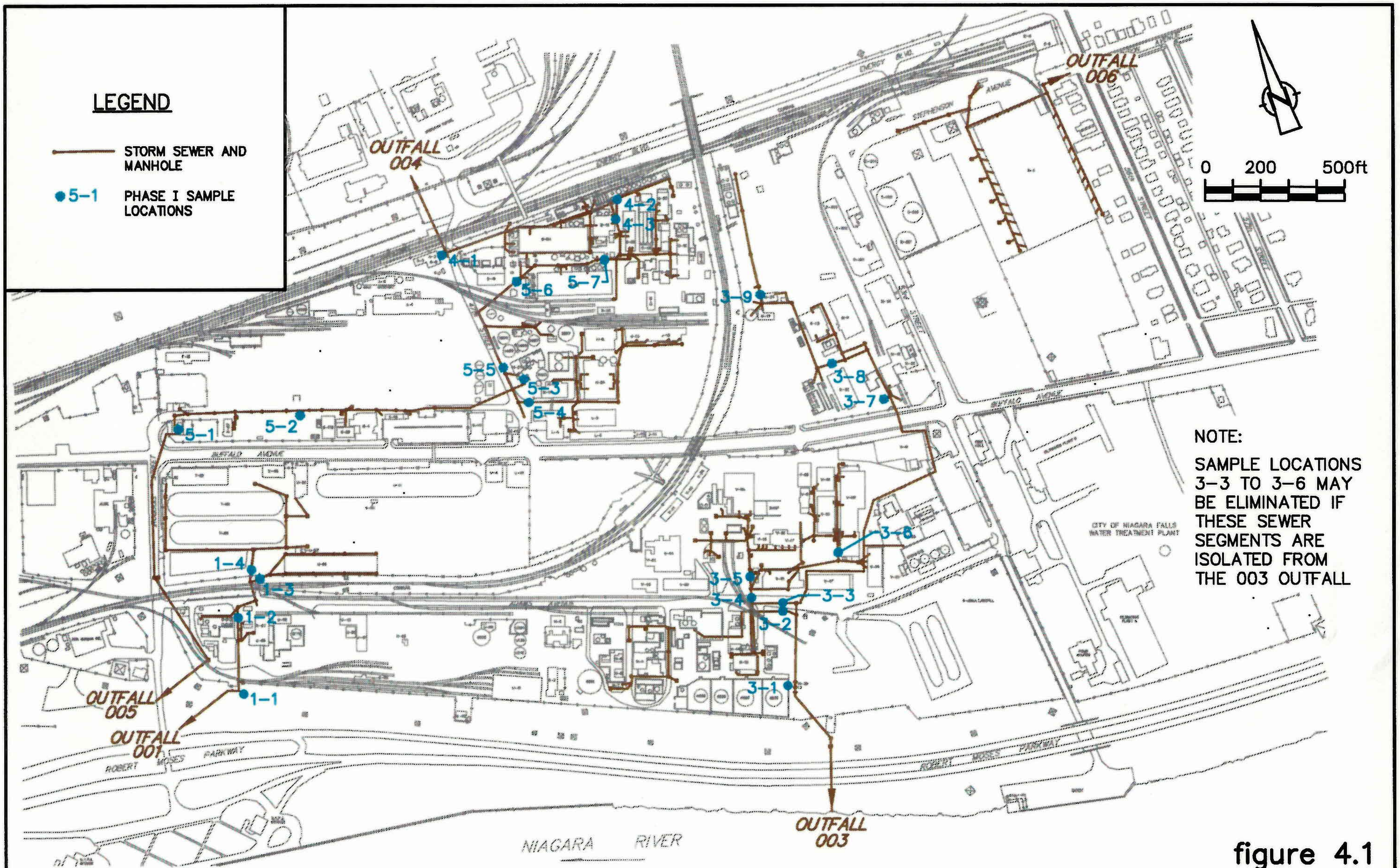


figure 4.1

PHASE I OUTFALL SEWER SAMPLING LOCATIONS
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA

2583 (153) AUG 15/94(W) REV.0 (P789)

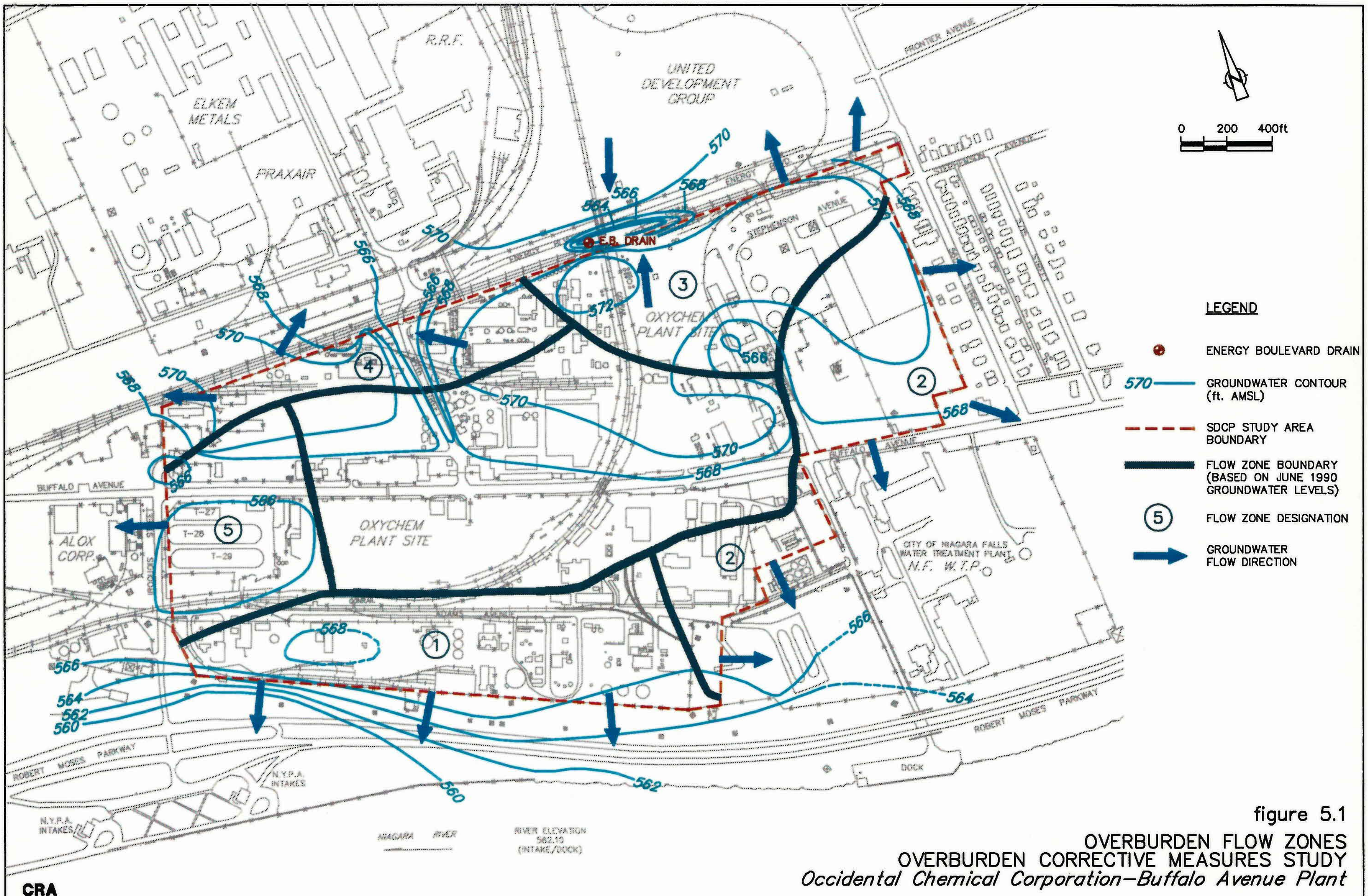


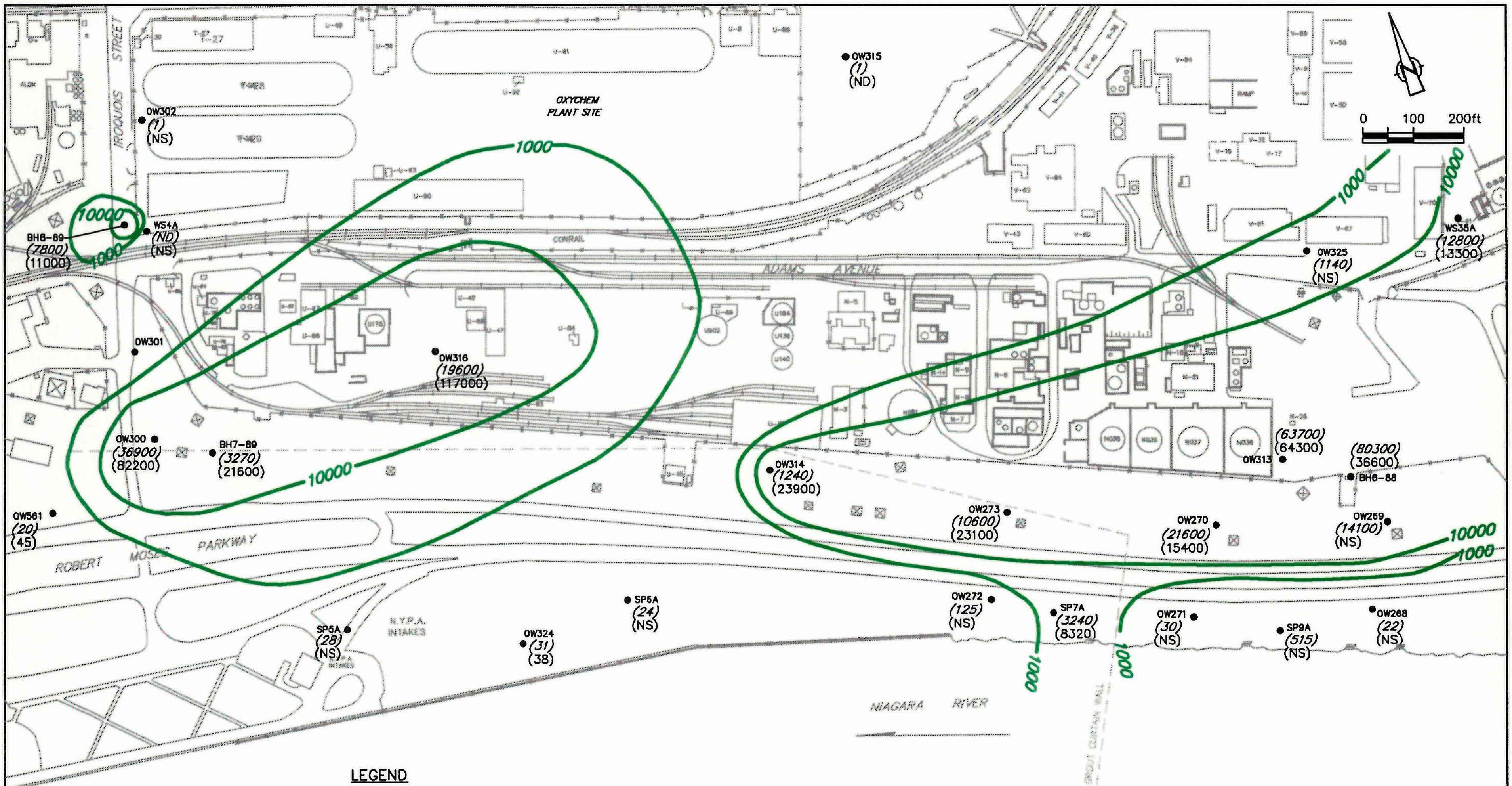
figure 5.1

OVERBURDEN FLOW ZONES

OVERBURDEN CORRECTIVE MEASURES STUDY

Occidental Chemical Corporation—Buffalo Avenue Plant

2583 (153) AUG 13/94(W) REV.1 (P788)



LEGEND

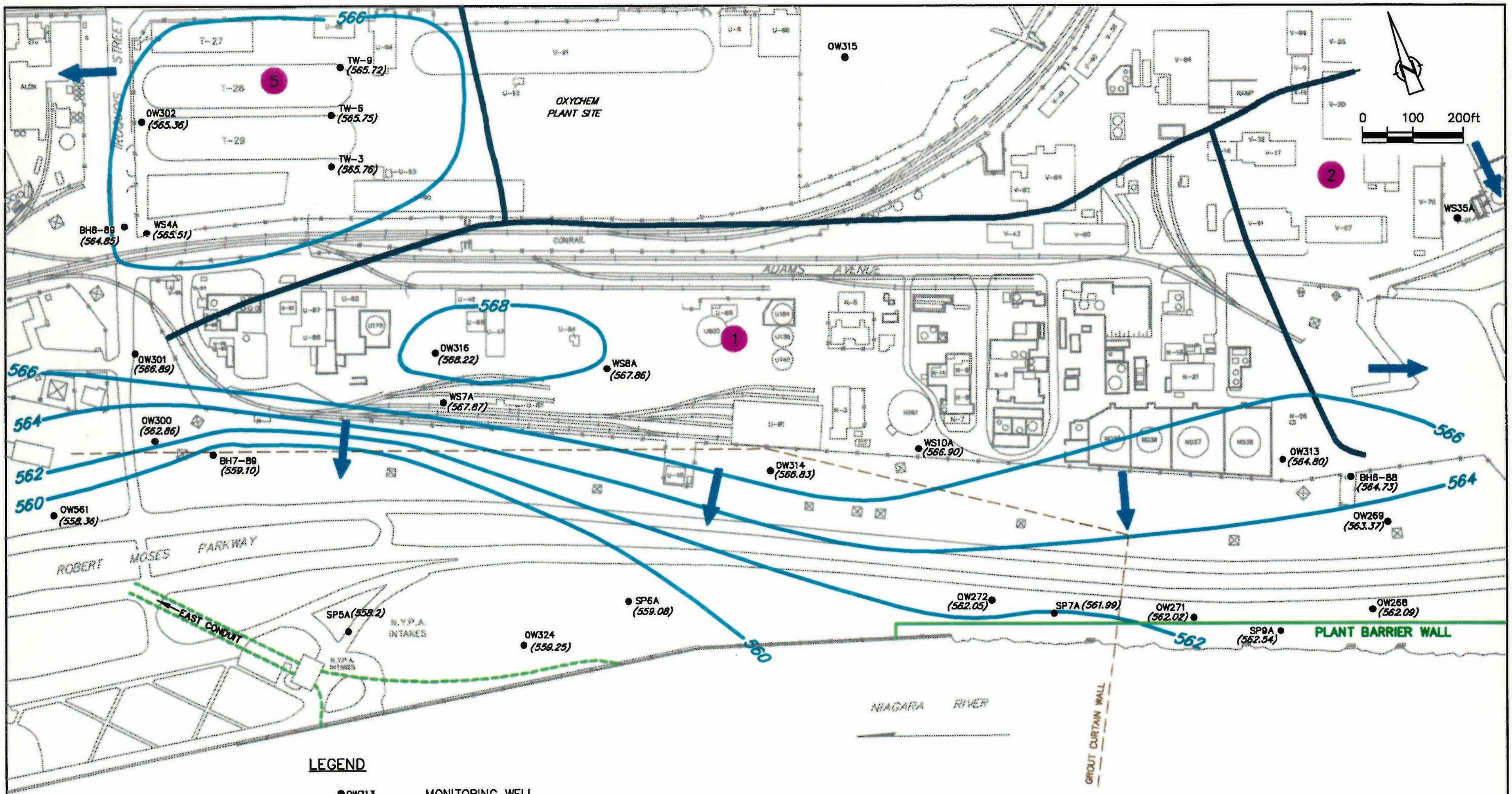
●OW313	MONITORING WELL SAMPLED ROUND 1/2-SSI	(130)	SECOND ROUND TOTAL ORGANIC SSI COMPOUNDS CONCENTRATION (ug/L)
(ND)	BELOW METHOD DETECTION LEVEL	*	AVERAGE OF DUPLICATE SAMPLE ANALYSIS
(NS)	NOT SAMPLED	*1000* ——	ISOPLETH CONTOUR (ug/L) (BASED ON SECOND ROUND DATA)
(340)	FIRST ROUND TOTAL ORGANIC SSI COMPOUNDS CONCENTRATION (ug/L)		

figure 5.2

FLOW ZONE 1 – ORGANIC COMPOUND PLUMES
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA

2583 (153) AUG 13/94(W) REV.0 (P790)



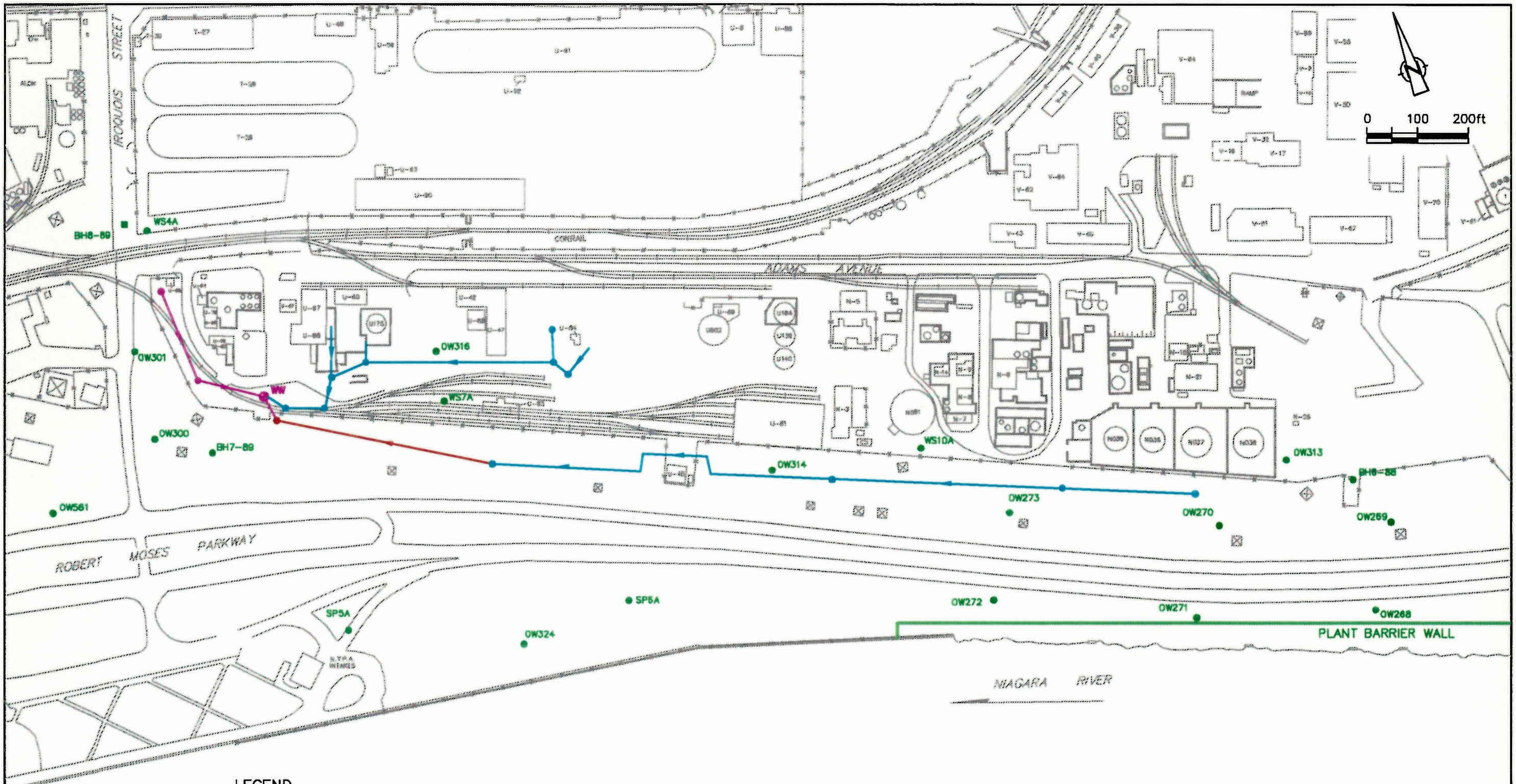
LEGEND

figure 5.3

FLOW ZONE 1 – GROUNDWATER FLOW EXISTING CONDITIONS
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA

2583 (153) AUG 12/94(W) REV.0 (P785)



LEGEND

- OW313 — EXISTING OVERBURDEN PERFORMANCE MONITORING WELLS
- NEW GROUNDWATER COLLECTION TILE AND WET WELL
- ABANDONED SEWERS UTILIZED AS GROUNDWATER COLLECTION SYSTEMS
- ABANDONED STEEL SEWER FOR GROUNDWATER TRANSFER
- WW — WET WELL

figure 5.4

FLOW ZONE 1 – GROUNDWATER COLLECTION SYSTEM STAGE 1
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA

2583 (153) AUG 13/94(W) REV.0 (P787)

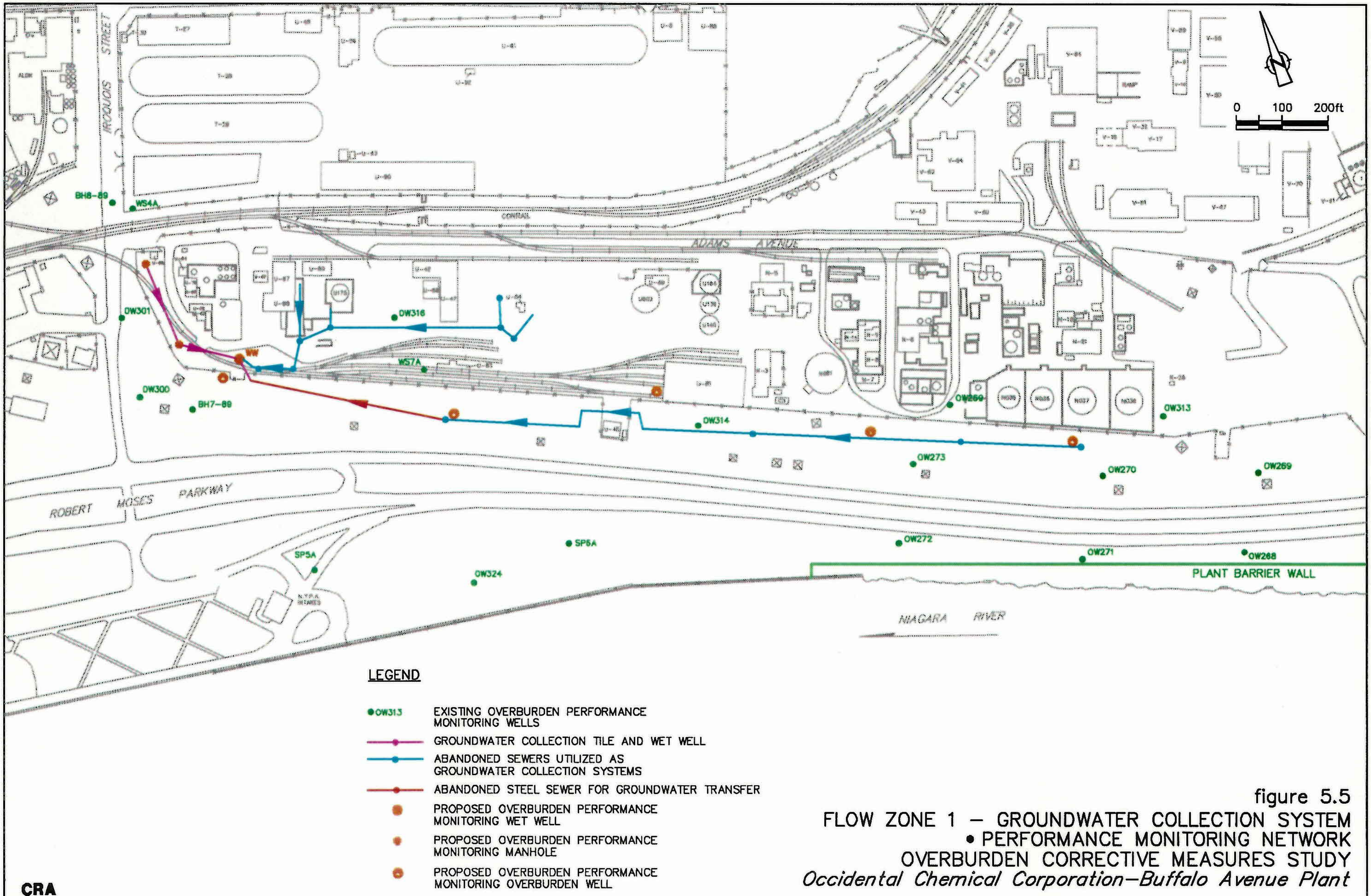


figure 5.5
FLOW ZONE 1 – GROUNDWATER COLLECTION SYSTEM
• PERFORMANCE MONITORING NETWORK
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

2583 (153) AUG 13/94(W) REV.0 (P786)

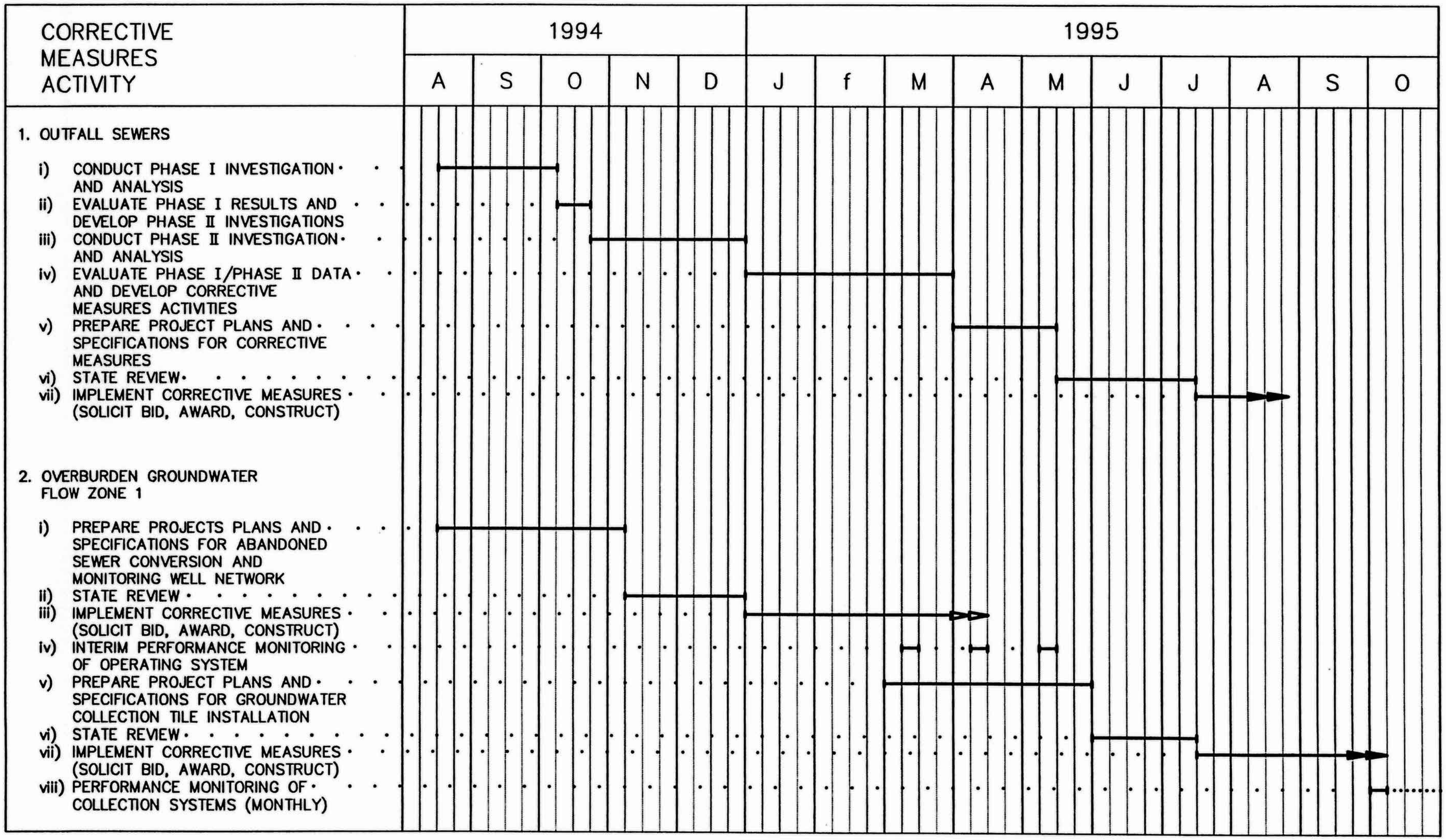


figure 6.1
IMPLEMENTATION SCHEDULE
OVERBURDEN CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation

TABLES

TABLE 3.1

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN THE BUFFALO AVENUE PLANT

Outfall Systems	*Location*	*Sewer Modification*	*Date*
Outfall 001	Outlet Structure	Sediment removal	November 1981
	MH518/MH521	Temporary inflatable plug placement	1984/1985±
	Metering chamber/ Interceptor chamber	Replacement of chamber manholes and piping	June 1985
	MH520-MH584	Lining of 36-inch sewer section	June 1985
	MH584	Severance and abandonment of easterly U-Area system	June 1985
	MH520	Severance and abandonment of easterly stub	August 1989
		Replacement of sewer section to northeast to service T-Area	August 1989
	MH518	Severance and abandonment of northeasterly stub	August 1989
	T-Area	Installation and connection of new storm system servicing T-Area bag storage facility contributing into MH518 north	August 1989
	U-Area	Mercury abatement discharges diverted to sanitary sewer	November 1989
	MHCB7-MH585	Clean and line manholes and sewer	October 1990 through May 1991
Outfall 002	--	Closure of entire outfall system	December 1982
Outfall 003	MH716	Severance and abandonment of westerly 24-inch stub	Early 1985
	V-Area (MH703, MH769 and others)	Miscellaneous stub closures by plugging	Unknown
	Lift Station	Severance and abandonment of easterly 24-inch stub from MH424 to lift station	June 1985
	Metering chamber/ Interceptor chamber	Replacement of chamber manholes and piping	December 1986

TABLE 3.1

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN THE BUFFALO AVENUE PLANT

Outfall Systems	*Location*	*Sewer Modification*	*Date*
	D-Area	Severance and abandonment of numerous stubs	1988/1989±
Outfall 004	Energy Boulevard	Installation of Energy Boulevard Drain Tile System	November 1981
	MH93E	Severance and abandonment of southern 36-inch stub	1987/1988±
	B/C-Area (MH97B, MH78 and MH77A)	Miscellaneous stub closures by plugging	Various
Outfall 005	Outlet Structure	Sediment removal from outlet structure	November 1981
	H-Area	Modify H-20 Pump Station discharge to outlet at MH159A. Original outlet was at City MH155	March 1984
	K-28 Lift Station Modifications	Outlet forcemain section elevated above ground from K-28 to property line	November 1986
	159A-MH159N	Lining of main line sewer. Majority of F-Area stubs contributing to the 005 Outfall were abandoned	December 1986
	MH159N	Liner repair to address NAPL NAPL entry at 42-inch easterly stub	June/July 1989
	H-Area (MH221, MH214, MH56H)	Miscellaneous stub closures by plugging	Various

TABLE 3.1

MAJOR SEWER SYSTEM MODIFICATIONS WITHIN THE BUFFALO AVENUE PLANT

Sanitary Sewer Systems	*Location*	*Sewer Modification*	*Date*
Iroquois Street Sanitary Sewer	U-Area West (residue burner, MH595, U-42 west)	Various sanitary connections and materials abandoned	Various
	U-Area East (MH597, MH598)	Various sanitary connections abandoned	Various
	N-Area (MH572, MH573, MH574)	Various sanitary connections and laterals abandoned	Various
	N-Area (MH767)	Install organic separator	September 1979
	N-Area	Closure of lagoon (MH764)	January 1988±
	T-Area (MH503, MH502)	Various sanitary connections and laterals abandoned	Various
	U-Area North (MH529B, lift station, MH546)	Numerous sanitary connections catchbasins, laterals and sewer sections abandoned	Various
	U-Area North East (MH545)	Abandon southerly sewer sections and manholes	Various
	V-Area West (MH651, MH653)	Numerous sanitary connections, catchbasins, laterals and sewer sections abandoned	Various
	V-Area East (MH697, MH695; MH664, MH670, MH677, MH699, City MH769D)	Various sumps, catchbasins, laterals and connections abandoned	Various
	F-Area West/East (MH144, MH143, MH141, MH139, MH128, MH136, MH147, MH127, MH126, MH86, MH109, MH156)	Various sanitary laterals, catchbasins, sumps and sewer sections abandoned	May 1985

TABLE 3.1

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN THE BUFFALO AVENUE PLANT

Sanitary Sewer Systems	*Location*	*Sewer Modification*	*Date*
Iroquois Street Sanitary Sewer (continued)	V-Area	Various sanitary catchbasins, sumps and laterals abandoned	Various
	S-Area	Install servicing to S-Area trailer/office facility	Mid 1986
47th Street Sanitary Sewer	B-Area (MH48A, MH64, MH49, MH85A, MH68B, MH68D and B-24 & B-25 Building areas)	Sanitary sewer laterals, sumps, manholes and catchbasins abandoned	April 1981±
	D/E-Area (MH303, MH317, MH319)	Sanitary sewer laterals, catchbasins and sumps abandoned	September 1982
	D-Area (MH302, MH311, MH307, MH301, MH305, MH308, MH306, 53rd Street (15" Ø)	Sanitary sewer laterals, sumps, manholes, catchbasins, floor drains and roof drains abandoned	September 1982
	M-Area (MH441, MH435, MH404, MH322)	Sanitary sewer laterals and catchbasins abandoned	June 1983
	K/G-Area (MH114A, MH178)	Entire sewer section and laterals abandoned	October 1985±
	H-Area (MH56E, MH56G, MH26)	Entire sewer section, sumps, catchbasins and manholes abandoned	Various
	M/E-Area (City MH)	53rd Street sanitary (15" Ø) sewer abandoned	Various
	A-Area (MH153A, MH94, MH151, MH174)	Sanitary sumps, laterals and manholes abandoned	Various
	C-Area (MH67A, MH92A, MH96, MH97 MH91B, MH55, MH83)	Sanitary sewer laterals, sumps, manholes, catchbasins and roof drains abandoned	Various

TABLE 3.2

CHEMICALS INCLUDED IN TOTAL ORGANIC LOADING

Monochlorotoluene

Dichlorotoluene

Monochlorobenzotrifluoride

Dichlorobenzotrifluoride

Hexachlorocyclopentadiene

Monochlorobenzene

Dichlorobenzene

Trichlorobenzene

Tetrachlorobenzene

Trichloroethylene

Tetrachloroethylene

Hexachlorocyclohexane

Toluene

Hexachlorobutadiene

Mirex

Benzene

TABLE 4.1

SEWER STUDY SSI PARAMETERS

Analytes	*Units*	*Method Detection Level*
Total Organic Halides (TOX)	µg/L	50
Total Organic Carbon (TOC)	µg/L	1
Mercury	µg/L	0.1
Toluene	µg/L	1
Benzene	µg/L	1
Chlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
1,2,3-Trichlorobenzene	µg/L	1
1,2,4-Trichlorobenzene	µg/L	1
Trichloroethylene	µg/L	1
Tetrachloroethylene	µg/L	1
Chlorobenzoic Acids (Total)	µg/L	100

APPENDIX A

SEWER STUDY SSI ANALYTE SUMMARY

APPENDIX A

SEWER STUDY SSI ANALYTE SUMMARY

The sewer study SSI analyte list (Table 4.1) has been developed from review of the Plant SSI list, comprehensive analysis results of each outfall discharge for SSI analytes, and the 1993 SPDES semi-annual analysis results for the top 18 Great Lakes Toxic Priority Compounds. Table A-1 shows the 1993 SPDES semi-annual (average results) and comprehensive analysis results for the the top 18 Great Lakes Toxic Priority Compounds. Table A-2 shows Plant SSI compounds detected during the comprehensive analysis of the Plant outfalls.

The Plant SSI list forms the basis for the sewer study SSI analyte list. A number of analytes have been dropped as they were never detected during comprehensive analysis or during SPDES analysis. Analytes removed from this list are arsenic, lead, phosphorus Total Soluble (as P), hexachlorocyclohexanes (a,b,g,d), Mirex, chlorotoluenes, hexachlorobenzene, tetrachlorobenzenes (1,2,3,4; 1,2,4,5), chlorobenzotrifluorides, and octachlorocyclopentene.

TABLE A.1

SPDES ANALYSIS/COMPREHENSIVE ANALYSIS
(GREAT LAKES TOXIC PRIORITY COMPOUNDS)
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION

Compound	MDL SPDES/COMP. ug/L	SPDES 1993 Semi-Annual Outfall				Comprehensive Analysis Outfall				To Be Included in Outfall Study
		001	003	004	005	001	003	004	005	
Arsenic	10/53	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(a)Anthracene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(a)Pyrene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(b)Fluoranthene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(k)Fluoranthene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Chlordane	0.30/0.30	ND	ND	ND	ND	ND	ND	ND	ND	No
Chrysene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
DDT & Metabolites	0.050/0.050	ND	ND	ND	ND	ND	ND	ND	ND	No
Dieldrin	0.050/0.050	ND	ND	ND	ND	ND	ND	ND	ND	No
2,3,7,8- TCDD	Note (1)	ND	ND	ND	ND	--	--	--	--	No
Hexachlorobenzene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Lead	5.0/5.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Mercury	0.010/0.1	0.25	0.25	0.20	0.20	1	0.1	ND	ND	Yes
Mirex	NA/2.0	--	--	--	--	--	--	--	--	No
Octachlorostyrene	0.30/0.30	--	--	--	--	ND	ND	ND	ND	No
PCBs Total	0.30/0.30	ND	ND	ND	ND	ND	ND	ND	ND	No
Tetrachloroethylene	2.0/2.0	71	80	4.5	ND	480	47	13	ND	Yes
Toxaphene	0.50/0.50	ND	ND	ND	ND	ND	ND	ND	ND	No

Notes:

(1) 2,3,7,8- TCDD screen monitor of ions 320 and 322

(2) Value obtained from average of 1993 SPDES Semi-Annual Monitoring Report
ND - Not detected at given MDL
-- Not Analyzed

TABLE A.2

COMPREHENSIVE ANALYSIS OF SSI COMPOUNDS - SEWER OUTFALLS
DETECTED COMPOUND SUMMARY

Compound	SSI Parameter (Yes/No)	Method Detection Limit (ug/l)	001 (ug/l)	003 (ug/l)	004 (ug/l)	005 (ug/l)	To Be Included In Outfall Study (Yes/No)
Total Organic Carbon(TOC)	Yes	1	NA	NA	NA	NA	Yes
Total Organic Halides(TOX)	Yes	50	1200	470/400	150	480	Yes
4-Chlorobenzoic Acid	Yes	100	270	ND	ND	ND	Yes
a-Hexachlorocyclohexane	Yes	0.05	ND	0.28/0.26	ND	0.08	No (1)
b-Hexachlorocyclohexane	Yes	0.05	0.3	0.35/0.39	ND	ND	No (1)
d-Hexachlorocyclohexane	Yes	0.05	ND	0.13/ND	ND	0.05	No (1)
Trichloroethylene	Yes	2	1300	6/5	ND	ND	Yes
Benzene	Yes	2	7	ND/ND	ND	ND	Yes
Tetrachloroethylene	Yes	2	480	49/44	13	ND	Yes
Toluene	Yes	2	16	2/ND	ND	ND	Yes
Chlorobenzene	Yes	2	15	4/4	ND	4	Yes
1,4-Dichlorobenzene	Yes	2	19	3/ND	ND	ND	Yes
1,2-Dichlorobenzene	Yes	2	6	ND/ND	ND	ND	Yes
Trichlorobenzene, Total	Yes	2	5	4/ND	ND	2	Yes
Hexachlorocyclopentadiene	Yes	2	ND	6/ND	ND	ND	No (1)
Benzoic Acid	Yes	2	8	8/ND	ND	ND	Yes
2,4,5-Trichlorophenol	Yes	2	ND	4/4	ND	ND	No (1)
Arsenic	Yes	53	ND	ND	ND	ND	No (1)
Mercury	Yes	0.1	ND	<1	ND	ND	Yes
Lead	Yes	42	ND	ND	ND	ND	No (1)

Note:
NA-Not Analyzed
ND- Not detected
(1) - Detection very low, therefore eliminated from program

APPENDICES

APPENDIX A

SEWER STUDY SSI ANALYTE SUMMARY

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SEWER STUDY SSI ANALYTE SUMMARY

The sewer study SSI analyte list (Table 4.1) has been developed from review of the Plant SSI list, comprehensive analysis results of each outfall discharge, and the 1993 SPDES semi-annual analysis results for the top 18 Great Lakes Toxic Priority Compounds. Table A-1 shows the 1993 SPDES semi-annual (average results) and comprehensive analysis results for the top 18 Great Lakes Toxic Priority Compounds.

The Plant SSI list forms the basis for the sewer study SSI analyte list. A number of analytes have been dropped as they were never detected during comprehensive analysis or during SPDES analysis. Analytes removed from this list are arsenic, lead, phosphorus Total Soluble (as P), hexachlorocyclohexanes (a,b,g,d) and Mirex.

TABLE A.1

SPDES ANALYSIS/COMPREHENSIVE ANALYSIS
(GREAT LAKES TOXIC PRIORITY COMPOUNDS)
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION

	MDL	SPDES 1993 Semi-Annual				Comprehensive Analysis				To Be
	SPDES/COMP.	Outfall				Outfall				Included
Compound	*ug/L*	*001*	*003*	*004*	*005*	*001*	*003*	*004*	*005*	*in Outfall Study*
Arsenic	10/53	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(a)Anthracene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(a)Pyrene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(b)Fluoranthene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Benzo(k)Fluoranthene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Chlordane	0.30/0.30	ND	ND	ND	ND	ND	ND	ND	ND	No
Chrysene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
DDT & Metabolites	0.050/0.050	ND	ND	ND	ND	ND	ND	ND	ND	No
Dieldrin	0.050/0.050	ND	ND	ND	ND	ND	ND	ND	ND	No
2,3,7,8- TCDD	Note (1)	ND	ND	ND	ND	--	--	--	--	No
Hexachlorobenzene	2.0/2.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Lead	5.0/5.0	ND	ND	ND	ND	ND	ND	ND	ND	No
Mercury	0.010/0.1	0.25	0.25	0.20	0.20	1	0.1	ND	ND	Yes
Mirex	NA/2.0	--	--	--	--	--	--	--	--	No
Octachlorostyrene	0.30/0.30	--	--	--	--	ND	ND	ND	ND	No
PCBs Total	0.30/0.30	ND	ND	ND	ND	ND	ND	ND	ND	No
Tetrachloroethylene	2.0/2.0	71	80	4.5	ND	480	47	13	ND	Yes
Toxaphene	0.50/0.50	ND	ND	ND	ND	ND	ND	ND	ND	No

Notes:

(1) 2,3,7,8- TCDD screen monitor of ions 320 and 322

(2) Value obtained from average of 1993 SPDES Semi-Annual Monitoring Report
ND - Not detected at given MDL
-- Not Analyzed

TABLE A.2

COMPREHENSIVE ANALYSIS OF SSI COMPOUNDS - SEWER OUTFALLS
DETECTED COMPOUND SUMMARY

Compound	*SSI Parameter* (Yes/No)	*Method Detection Limit (ug/l)*	*001 (ug/l)*	*003 (ug/l)*	*004 (ug/l)*	*005 (ug/l)*	*To Be Included In Outfall Study (Yes/No)*
Total Organic Carbon(TOC)	Yes	1	NA	NA	NA	NA	Yes
Total Organic Halides(TOX)	Yes	50	1200	470/400	150	480	Yes
4-Chlorobenzoic Acid	Yes	100	270	ND	ND	ND	Yes
a-Hexachlorocyclohexane	Yes	0.05	ND	0.28/0.26	ND	0.08	No (1)
b-Hexachlorocyclohexane	Yes	0.05	0.3	0.35/0.39	ND	ND	No (1)
d-Hexachlorocyclohexane	Yes	0.05	ND	0.13/ND	ND	0.05	No (1)
Trichloroethylene	Yes	2	1300	6/5	ND	ND	Yes
Benzene	Yes	2	7	ND/ND	ND	ND	Yes
Tetrachloroethylene	Yes	2	480	49/44	13	ND	Yes
Toluene	Yes	2	16	2/ND	ND	ND	Yes
Chlorobenzene	Yes	2	15	4/4	ND	4	Yes
1,4-Dichlorobenzene	Yes	2	19	3/ND	ND	ND	Yes
1,2-Dichlorobenzene	Yes	2	6	ND/ND	ND	ND	Yes
Trichlorobenzene, Total	Yes	2	5	4/ND	ND	2	Yes
Hexachlorocyclopentadiene	Yes	2	ND	6/ND	ND	ND	Yes
Benzoic Acid	Yes	2	8	8/ND	ND	ND	No (1)
2,4,5-Trichlorophenol	Yes	2	ND	4/4	ND	ND	No (1)
Arsenic	Yes	53	ND	ND	ND	ND	No (1)
Mercury	Yes	0.1	ND	<1	ND	ND	Yes
Lead	Yes	42	ND	ND	ND	ND	No (1)

Note:
NA-Not Analyzed
ND- Not detected
(1) - Detection very low, therefore eliminated from program